North Coast Area Strategic Plan
System Capacity Planning Project
Aurora Energy

Report ref:
200027-002
20 May 2010
Revision 5

aurecon

Document prepared by:

Aurecon Australia Pty Ltd
ABN 54 005 139 873
32 Turbot Street
Brisbane
Queensland 4000 Australia

T: +61 7 3173 8000
F: +61 7 3173 8001
E: brisbane@ap.aurecongroup.com
W: aurecongroup.com

Document control

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Document ID: North Coast area strategic plan Rev_5.doc

Rev No	Date	Revision details	Typist	Author	Verifier	Approver
0	19 November 2009	Draft Issue to Client	JLB/BK	JLB/BK	MSH	MSH
1	30 November 2009	Interim Report Issue to Client	JLB/BK	JLB/BK	MSH	MSH
2	12 February 2010	Draft Issue to Client (Strategic and Ten Year Plans)	JLB/BK	JLB/BK	MSH	MSH
3	26 March 2010	Draft Issue (Strategic, Ten and Five Year Plans)	JLB/BK	JLB/BK	MSH	MSH
4	11 May 2010	Draft final issue for comment	JLB/BK	JLB/BK	MSH	MSH
5	20 May 2010	Final Issue	NJG	JLB/BK	MSH	MSH

Contents

Executive summary

The long term plan for North Coast recommends the continuation of the existing philosophy of 110 kV transmission network with 110/22 kV terminal stations. There are no new terminal substations recommended before 2050 in the North Coast area. A new substation at Westbury in the Tamar area will deload Railton substation in 2017 and transfer the Deloraine load to the Tamar area. The transformers at the three existing substations of Wesley Vale, Devonport and Railton are recommended for replacement as part of the long term plan to increase capacity at the substations.

The ten year plan for North Coast recommends the conversion of the existing Wesley Vale substation to a 110/22 kV terminal substation. A transformer replacement at Wesley Vale is also recommended towards the end of the ten year time frame to increase capacity at the substation.

The five year plan for North Coast details the distribution works required for the installation of the Wesley Vale substation and the effect on the neighbouring substations, Devonport and Railton.

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 Coast covers an area west of Ulverstone to Devonport and south to the Cradle Mountain tourism area.

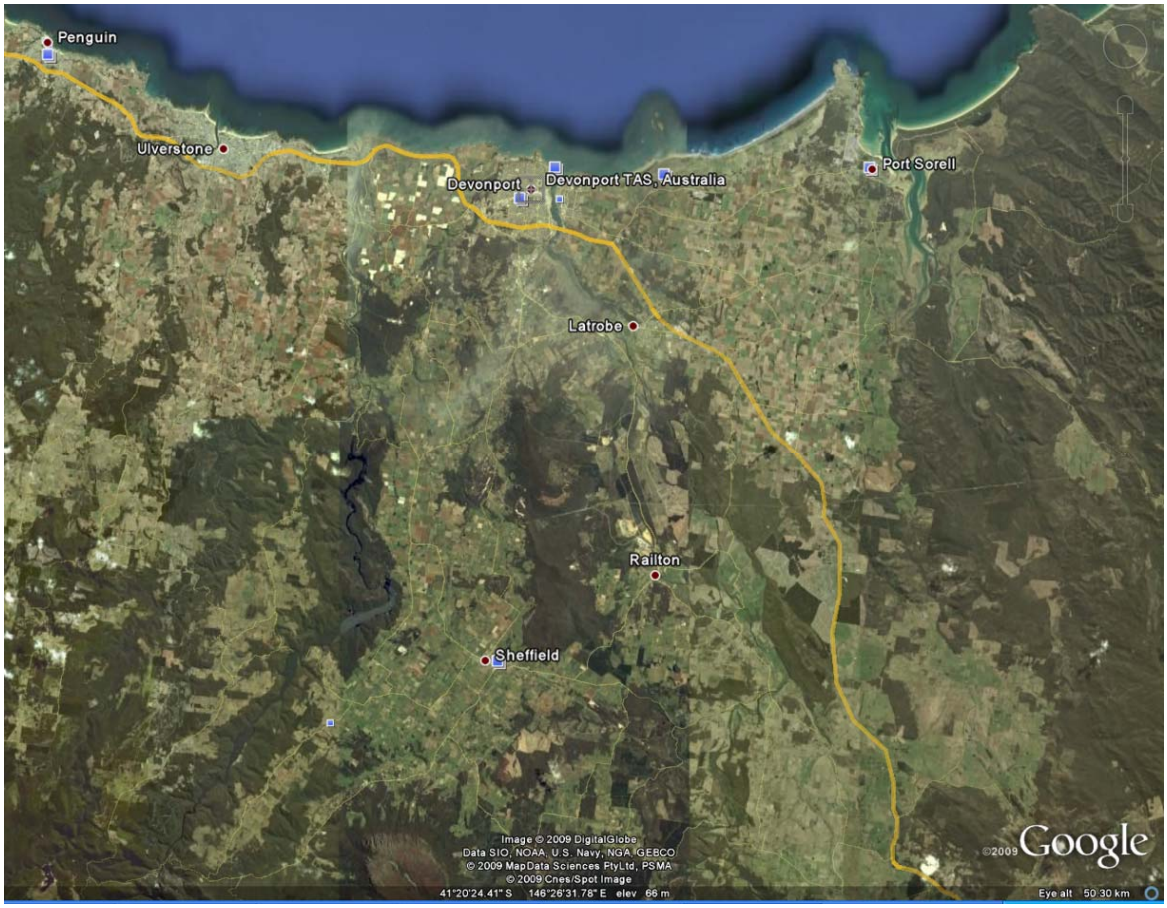


Figure 2-1 North Coast supply area

The industries in the North Coast area are a continuation from the North West area including commercial and residential towns along the coast and an inland farming industry. There is a strong tourism industry in the Cradle Mountain area and localised 'bubble' developments at Port Sorell and Hawley Beach.

2.1 Existing infrastructure

There are three Transend terminal substations supplying the North Coast area.

Table 2-1 North Coast terminal substations

Terminal Substation	Number of transformers	Rating of Each Transformer	Transformer Primary Voltage	Secondary Voltage	Number of Distribution Feeders
Devonport	3	30 MVA	110 kV	22 kV	11
Railton	2	50 MVA	110 kV	22 kV	8
Wesley Vale	2	22.5 MVA	110 kV	11 kV	1

2.2 Council areas and restrictions

The North Coast area covers four council areas: Devonport, Latrobe, Meander Valley and Kentish. Each council has its own planning schemes and strategic plans for their area.

Devonport

The Devonport Council has a strategic plan document for 2009-2030. This document outlines the main goals of the council. The priorities of the Devonport council include living lightly on the environment, building a unique city, growing a vibrant economy, building quality of life and practicing excellence in governance.

The Devonport planning scheme was originally published in 1984 and includes amendments up to August 2009. 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 Coast.

Latrobe

The Latrobe Council has a strategic plan document for 2006-2011. This document outlines the main goals of the council. The priorities of the Latrobe council include leadership, community participation, natural resource management, employee management, asset management and regional co-operation.

The Latrobe township and environs strategic plan was adopted by council in September 2009. One of the major recommendations of this strategy is the extension of residential and commercial developments eastwards of the existing area.

The Latrobe Council area also includes the high growth area of Port Sorell and Hawley Beach. The Port Sorell and environs strategic plan was released in 2008. The strategy recommends:

- New development to be concentrated around the new Alexander Street town centre
- Development in the Shearwater area to attract and support tourism and leisure activities
- Shearwater village commercial development
- Residential site development in and to the west of Rubicon Grove
- Arthur Street area residential development
- Port Sorell Marina site
- Expansion of Hawley residential development and tourist accommodation

Meander Valley

The Meander Valley Council has a strategic plan document for 2004-2014. This document outlines the main objectives of the council. The priorities of the Meander Valley council include natural and built environment, economic growth, creative community learning, heath and well being, working together and infrastructure and services.

The Meander Valley planning scheme was originally published in 2007. 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 plans for the North Coast and Tamar areas. The document also outlines strategies for individual areas.

- Deloraine – develop industrial development in the East Goderich/Lake highway precinct and the Butter Factory site on mole Creek Road
- Westbury – develop industrial development in the vicinity of Tasmanian Alkanoids off Birralee Road, promote low density residential development
- Prospect Vale – encourage commercial uses and restrict industrial, key area for residential growth
- Blackstone Heights – will not be promoted for residential development
- Hadspen – significant growth area between Meander Valley Road and the South Esk River
- Mole Creek – promote future incremental residential growth

- Chudleigh/ Meander/Elizabeth Town – low density residential development
- Bracknell/Kimberley/Exton/Hagley – not promoted for future growth

Kentish

The Kentish Council has a strategic plan document for 2009-2014. This document outlines the main objectives of the council. The priorities of the Meander Valley council include environment stability, financial stability and community cohesion.

The Kentish Council planning scheme was originally published in 2005. 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 Coast.

2.3 Approved and proposed works

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

Wesley Vale terminal substation

The installation of Wesley Vale terminal substation has been further reviewed in this study. Refer to Sections 6.1.1, 0 and 8.3 for further information.

3. Load forecast

The growth in the areas around Devonport and Railton terminal substations vary between medium and high growth development. For the purposes of the long term strategic study, the assumed high growth areas include Wesley Vale (Devonport Airport), Latrobe, Port Sorell and Hawley Beach. The assumed medium growth areas include Devonport CBD and adjacent developed areas to the south and west, Railton township and south/south east of Railton. This is outlined further in the geographic view in Figure 3-2.

The resulting 38 year load forecast and firm ratings for the Devonport and Ulverstone substations are provided below.

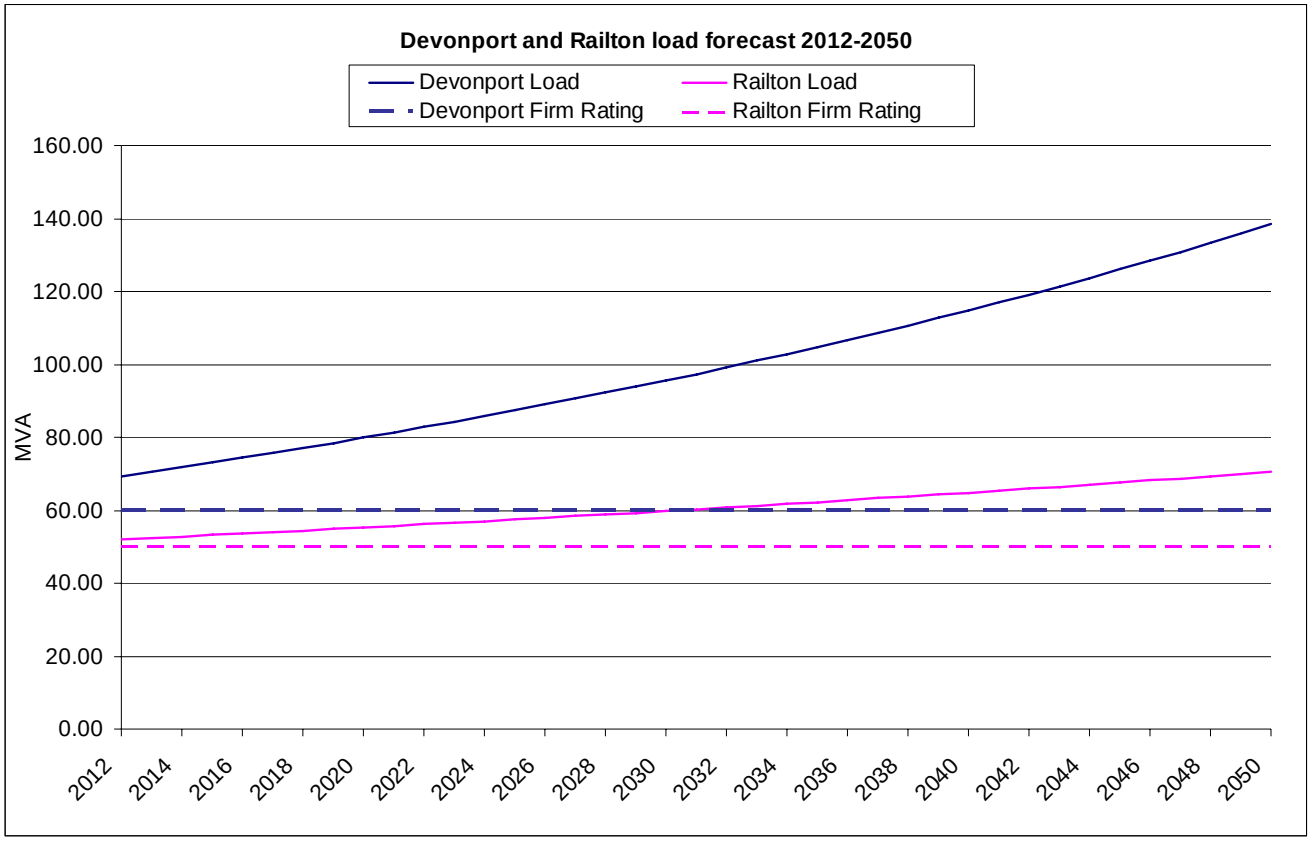


Figure 3-1 Substation load forecast for Devonport and Railton

The load distributions for the two substations are shown in the following figure. The red circles denote areas with a proposed high growth forecast.

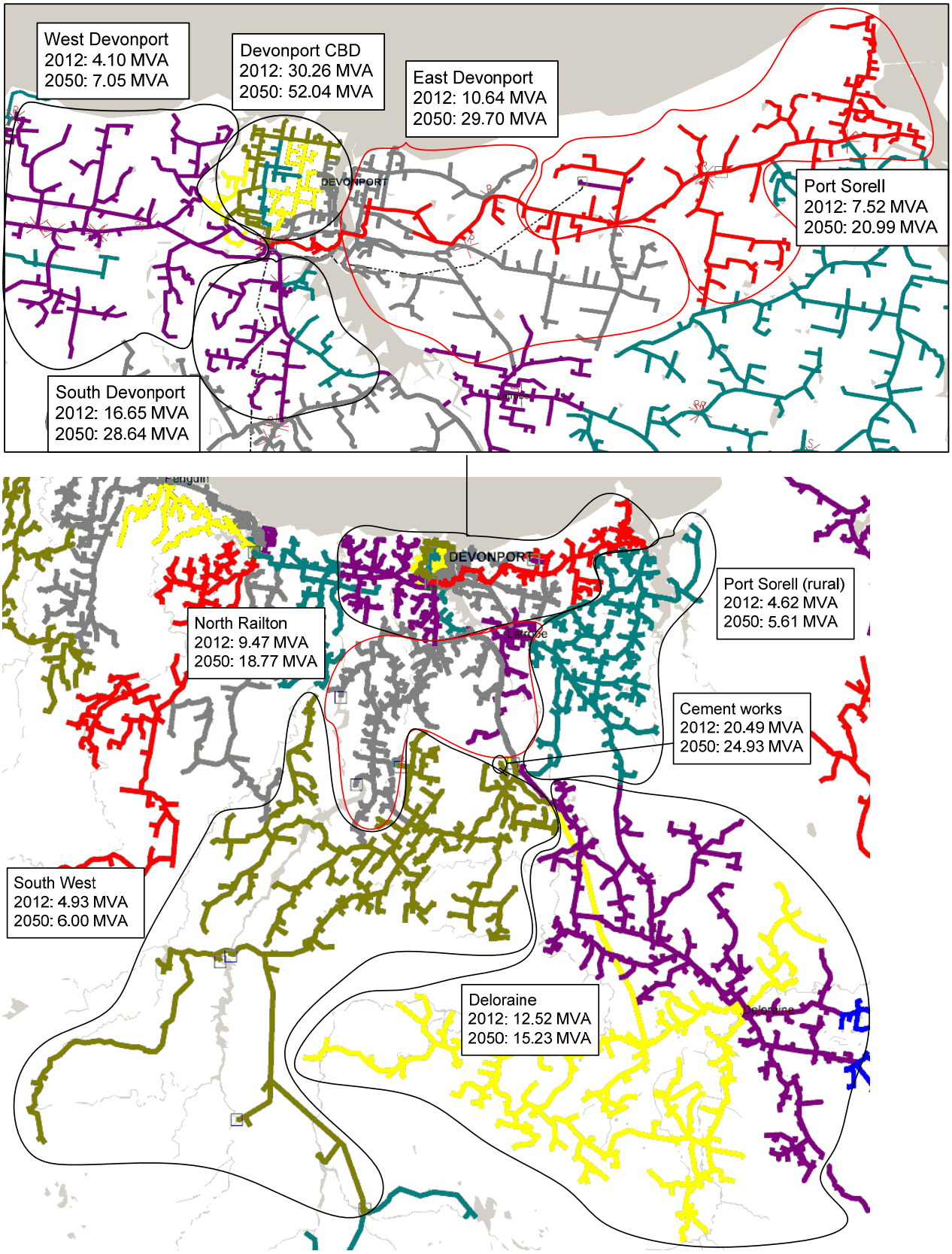


Figure 3-2 Substation load distribution for Devonport and Railton

4. Limitations

4.1 Devonport

There are three 30 MVA 110/22 kV transformers at Devonport terminal substation. The forecast load for 2009 is 65 MVA and the firm capacity has already been exceeded. The distribution feeders are heavily loaded and two feeders were overloaded in 2009. There are no spare circuit breakers on the existing 22 kV switch board but there is room for four future panels.

Devonport terminal substation supplies two urban areas in Devonport City and Port Sorell and the high density rural area in between these two points.

The 110/22 kV 30 MVA transformers at Devonport were installed in 1996 (x2) and 2000. Assuming an asset life of 50 years, these transformers are predicted to need replacement around 2046.

4.2 Railton

Railton terminal substation has two 50 MVA 110/22-11 kV transformers. The forecast load for 2009 is 50.7 MVA and the firm capacity has been exceeded. The distribution feeders are heavily loaded and two feeders were overloaded in 2009. There are no spare circuit breakers on the 22 kV switch board.

Railton substation supplies the high density rural area in Deloraine and a very large low density rural area to the south of Devonport.

The 110/22 kV transformers at Railton were installed in 1982. Assuming an asset life of 50 years, these transformers are predicted to require replacement around 2032.

5. Planning philosophy

Devonport substation currently supplies a very large area including two urban areas in Devonport City and Port Sorell and the high density rural area in between these two points.

The ultimate plan for Devonport substation is to supply the Devonport CBD and to the west of the CBD. The Wesley Vale substation will provide support to the east and provide a reliable supply for the Port Sorell urban area. The Railton substation will focus on the rural load to the south and the cement works. This philosophy will provide a more reliable network of substations and will decrease feeder lengths throughout the 22 kV network.

A conduit plan for the Devonport 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 in the direction of the CBD. This is further discussed in the five year plan in Section 8.1.

6. Long term strategy

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 M (RIT-D) or $5 M (RIT-T).

6.1 Proposed projects

6.1.1 Wesley Vale terminal substation

The existing Wesley Vale substation is located to the west of Devonport and close to the Devonport airport. This substation currently supplies a direct connected customer, Tasmanian Paper, at 11 kV with four 11 kV customer feeders. However, the plant is to be shut down by June 2010 which will remove the requirement for an 11 kV supply in the area. An additional factory site is supplied by a 1.8 km 22 kV cable that is operating at 11 kV.

It is recommended that the windings on the two 110/22/11 kV 22.5 MVA transformers be changed in 2012 to operate at 22 kV. The direct connected customer will be converted to 22 kV and load transfers will assist with deloading Devonport and Railton. This will delay the replacement of the existing transformers at Devonport.

More information on this project is available in the ten year and five year plans in Sections 7.1.1 and 8.3.

6.1.2 Westbury terminal substation

It is recommended that a new terminal substation is established in Westbury in 2017. Two 110/22 kV 60 MVA transformers should be installed. This will address the firm capacity issues at Hadspen and also at Railton and Devonport in the North Coast area. Large industrial point loads are expected in the Westbury area and Hadspen will be unable to support the large load increases.

More information on this project is available in the Tamar area strategic plan – Report 1 in the series.

6.1.3 Wesley Vale transformer replacement

The existing Wesley Vale 110/22-11 kV 22.5 MVA transformers were installed in 1970 and 1971. It is recommended that the transformers be replaced in 2021. This will increase the firm capacity of the substation and will also align with the predicted age limitation of the transformers.

6.1.4 Railton transformer replacement

It is recommended that the transformers at Railton be replaced with two 110/22 kV 60 MVA transformers in 2032. This will increase the firm capacity at the substation and will also align with the predicted transformer age limitation. This timing can be refined further by monitoring the growth on the substations and completing regular testing on the transformers as they approach the 50 year mark.

6.1.5 Devonport transformer replacement

It is recommended that the three transformers at Devonport substation be replaced with three 110/22 kV 60 MVA transformers. The transformers will be installed in the 2040s. This project will double the firm capacity of the Devonport substation. Distribution feeder works will be required to obtain an optimal feeder loading on each of the existing feeders. There are no existing spare circuit breakers but there is room for four future panels on the switchboard.

6.1.6 Devonport 22 kV switchgear extension

It is recommended that the 22 kV switchgear at Devonport be extended in 2046. This will allow the spare firm capacity of the substation to be fully utilised. The timing for this project will be refined dependent on the load growth in the Devonport area.

6.2 Summary of proposed works

A summary of the proposed works from 2012 to 2050 in the North Coast planning area is outlined in Table 6-1.

Table 6-1 North Coast project summary

Year	Proposed Project	Proposed Outcomes
2012	Conversion of Wesley Vale terminal station	Address firm capacity issues Devonport and Railton, improved reliability for North Coast area
2017	Westbury terminal station	Address firm capacity issues at Railton and Hadspen (Tamar area), improved reliability of supply to the Deloraine and Westbury area
2022	Wesley Vale transformer replacement	Address firm capacity issues Devonport and Railton, improved reliability for North Coast area
2032	Railton transformer upgrade	Addresses firm capacity and age limitations at Railton
2040s	Devonport transformer replacement	Address firm capacity issues at Devonport and Railton
2046	Devonport 22 kV switchgear extension	Utilise spare firm capacity at Devonport

The resulting load forecast curves and new firm ratings are outlined below in Figure 6-1.

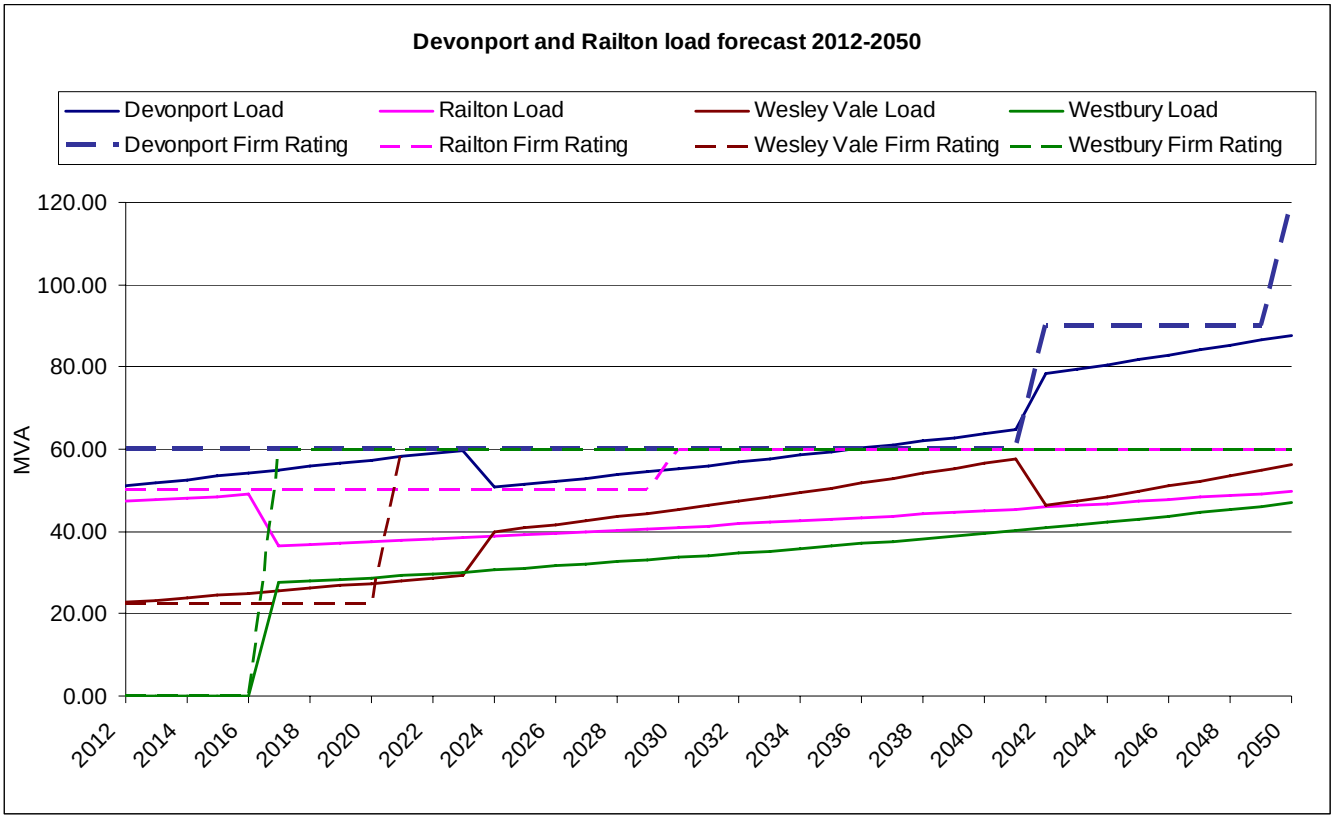


Figure 6-1 Devonport/Railton area forecast and proposed ratings

The proposed new supply area for each of the substations in 2050 is outlined in Figure 6-2 below.

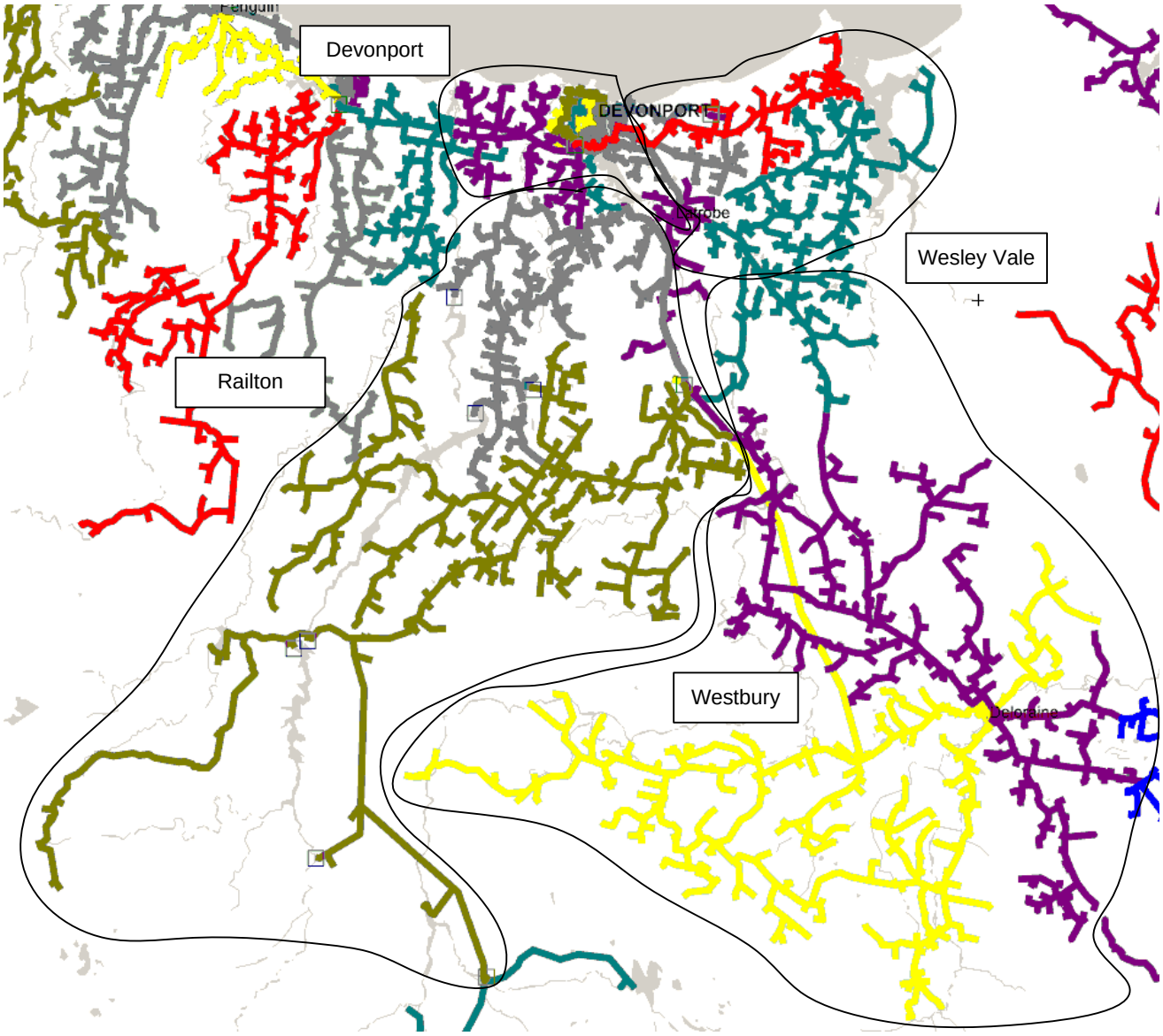


Figure 6-2 Proposed supply areas for North Coast substations

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 Wesley Vale terminal substation conversion

The existing Wesley Vale substation is located to the west of Devonport and close to the Devonport airport. This substation currently supplies a direct connected customer, Tasmanian Paper, at 11 kV with four 11 kV customer feeders. However, the plant is to be shut down by June 2010 which will remove the requirement for an 11 kV supply in the area. An additional factory site is supplied by a 1.8 km 22 kV cable that is operating at 11 kV.

Limitations

Devonport terminal substation has three 30 MVA 110/22 kV transformers. The terminal substation load in 2012 is forecast to be 69.17 MVA and it is forecast to grow to 82.82 MVA in 2022. This load is well above the firm capacity of the substation.

Railton terminal substation has two 50 MVA 110/22-11 kV transformers. The forecast load for 2012 is 52.02 MVA and it is forecast to grow to 56.15 MVA in 2022. The distribution feeders are heavily loaded and there are no spare circuit breakers on the 22 kV switchboard.

High residential growth is forecast for the Port Sorell and Hawley Beach areas to the east of Devonport. These areas are currently supplied by long feeders from Devonport and Railton and reliability is an issue.

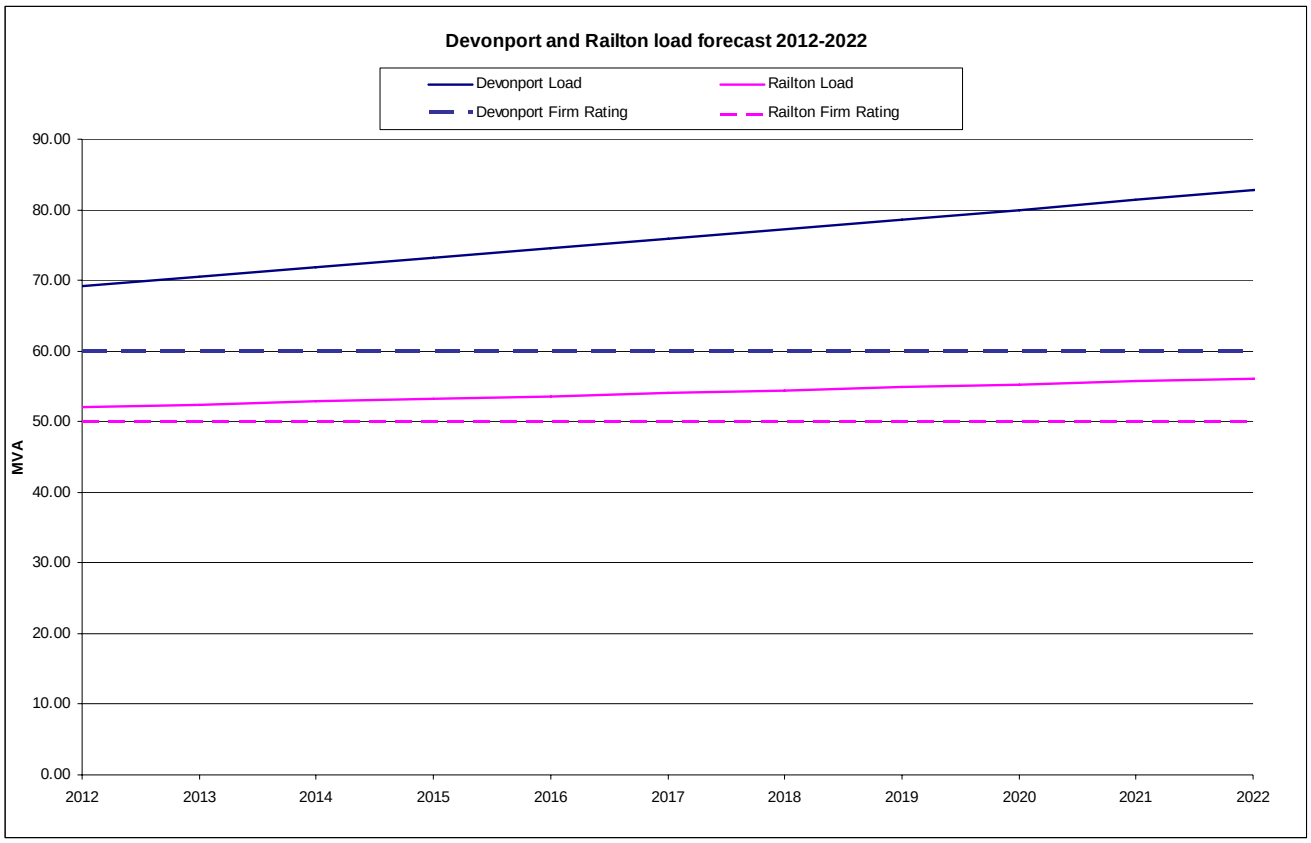


Figure 7-1 Devonport and Railton ten year forecast

Option 1 – Conversion of Wesley Vale to an 110/22 kV connection point

It is recommended that the two existing 110/22/11 kV transformers be converted to operate at 110/22 kV utilising the existing 22 kV switchgear (currently operating at 11 kV). A 22/11 kV transformer will be required for the furniture factory currently supplied at 11 kV.

Option 2 – Transformer replacement and new 22 kV feeders from Devonport

This option includes the replacement of the three existing 110/22 kV 30 MVA transformers with three 110/22 kV 60 MVA transformers. This will address short term loading issues at Devonport substation and provide firm capacity for the future growth in the area.

Option 3 – Non-network option

No non-network alternatives have been considered.

Option 4 – Do nothing option

The do nothing option is not considered a feasible option as the firm capacity at Devonport and Railton has been exceeded.

Technical comparison

Option	Description	Advantages	Disadvantages
1	Conversion of Wesley Vale to an 110/22 kV connection point	• Addresses firm capacity limitations at Devonport and Railton • Highest operational flexibility • Consistent with network development plan (remove surrounding load from Devonport so it can feed the CBD) • Utilises existing 22 kV feeders that run past the site • Utilises existing site and transformers/switchgear	•
2	Replacement of the Devonport transformers	• Addresses firm capacity limitations at Devonport and Railton • Utilises existing site	• Not consistent with network development plan (Devonport to focus on immediate substation supply area) • Construction of long 22 kV feeders required • Feeder congestion around substation and towards Wesley Vale • Devonport transformers were only recently installed

Cost comparison

Table 7-1 Cost comparison of options

Option	Initial Capital Cost ($M)	Total Capital Cost ($M)	Net Present Value ($M)
1	1.2	18.9	5.2
2	11.7	18.9	13.8

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:

- Changeover to the 22 kV windings
- Switchboard modifications as required (existing switchboard is suitable for 22 kV)

The scope of works for Aurora includes:

- Installation of a 22/11 kV transformer at the substation or at the customer
- Installation of 22 kV feeder tails. Further details are provided in the five year plan in Section 8.3.

Related projects

The conversion of the Wesley Vale substation in 2012 addresses the firm capacity issues at both Devonport and Railton. Any changes to the proposed option or the timing of this project will affect both of these substations. This project links with the installation of the Westbury substation in 2017 and the replacement of the Wesley Vale transformers due firm capacity and age limitations in 2021. Both of these projects will further relieve Railton substation and the timing of the projects will be affected based on the Wesley Vale conversion project. For further information on the Westbury substation installation, refer to the Tamar area strategic plan – Report 1 of the series. For further information on the Wesley Vale transformer replacement, refer to the following section.

7.1.2 Wesley Vale transformer replacement

Wesley Vale substation will supply the area surrounding the substation, east to Port Sorell and Hawley Beach and south to Latrobe.

Limitations

The firm capacity of the transformers at the Wesley Vale substation will be exceeded prior to 2021, dependent on the load initially transferred to the substation. The load at Devonport will also be approaching firm capacity in 2021.

The transformers at Wesley Vale terminal substation were installed in 1970 and 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 Wesley Vale substation

The first option is to replace the two existing 110/22 kV 22.5 MVA transformers with two new 110/22 kV 60 MVA transformers in 2021. This will address the firm capacity issues at Wesley Vale and Devonport and also align with the predicted age limitation of the existing transformers at Wesley Vale.

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 Wesley Vale and Devonport substations both have firm capacity issues.

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 Coast planning area are listed in Table 7-2.

Table 7-2 North Coast project summary

Year	Proposed Project	Proposed Outcomes
2012	Wesley Vale terminal station	Address firm capacity issues Devonport and Railton, improved reliability for North Coast area
2021	Wesley Vale transformer replacement	Address firm capacity issues and predicted age limitations on the existing Wesley Vale transformers

The resulting forecast including the North Coast projects is shown below. The Westbury substation project is also shown to highlight the load transferred from Railton to Westbury in the Tamar area.

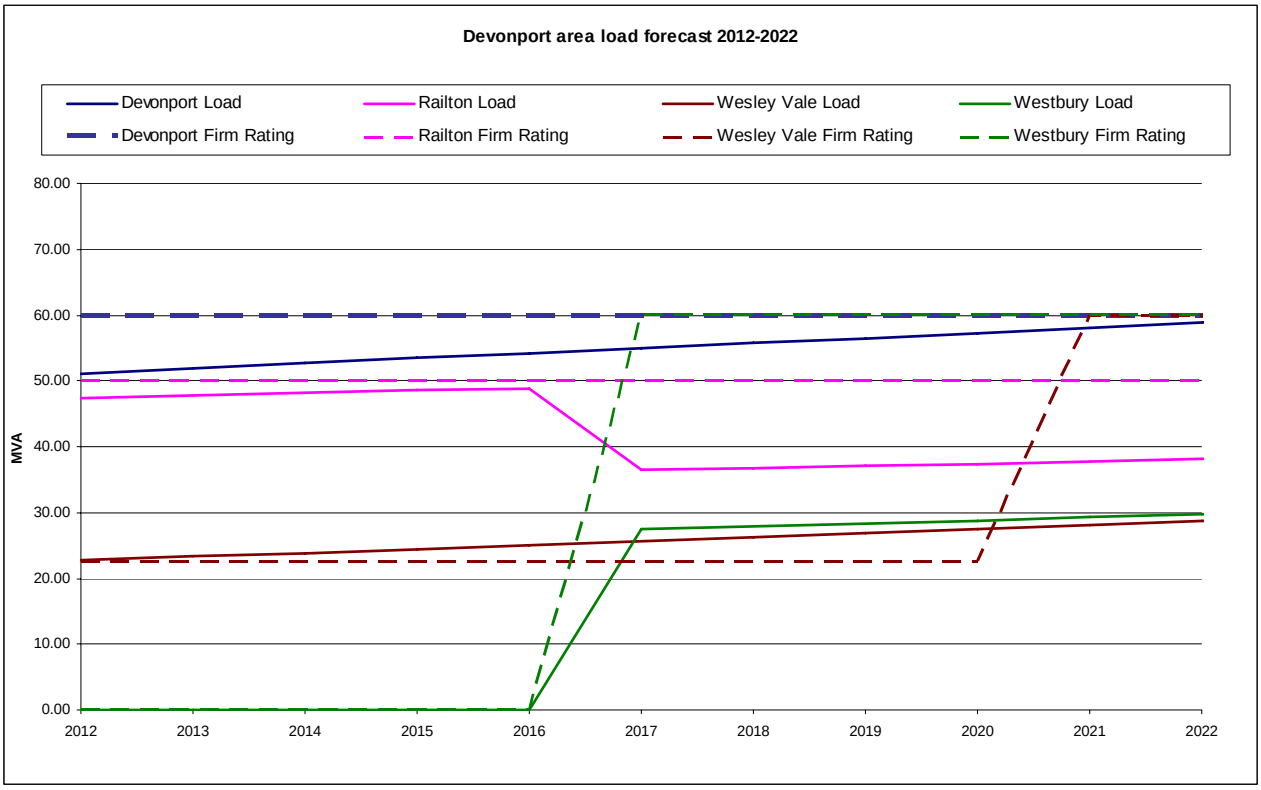


Figure 7-2 Devonport area ten year forecast

8. Five year plan

A five year plan for each of the substations (including proposed new substations) in the North Coast 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 Devonport substation

Devonport terminal substation supplies the urban areas of Devonport city and Port Sorell and high density rural areas to the west and south of Devonport.

8.1.1 Limitations

Using the medium growth forecast, the Devonport terminal substation load in 2012 is forecast to be 51.01 MVA and it is forecast to grow to 55 MVA in 2017. The load in 2010 is above the firm capacity of the substation, however the upgrade of the Wesley Vale substation will deload Devonport in 2012.

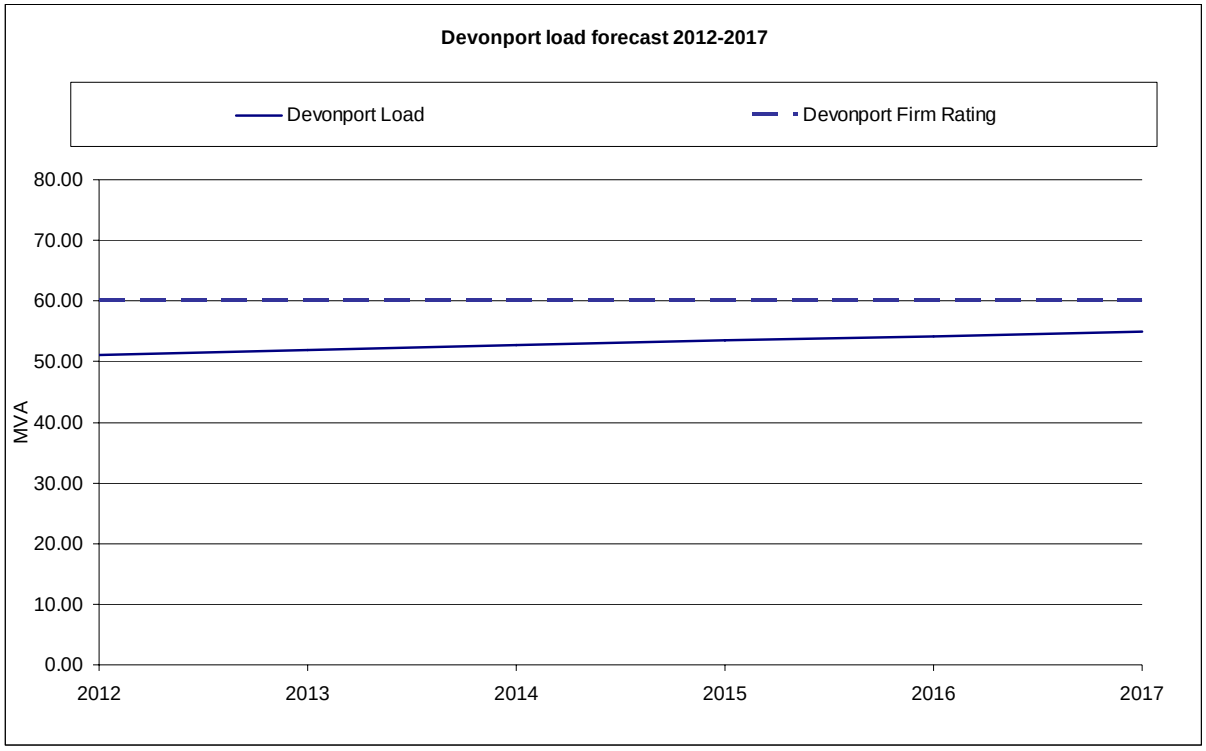


Figure 8-1 Substation five year medium growth forecast

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

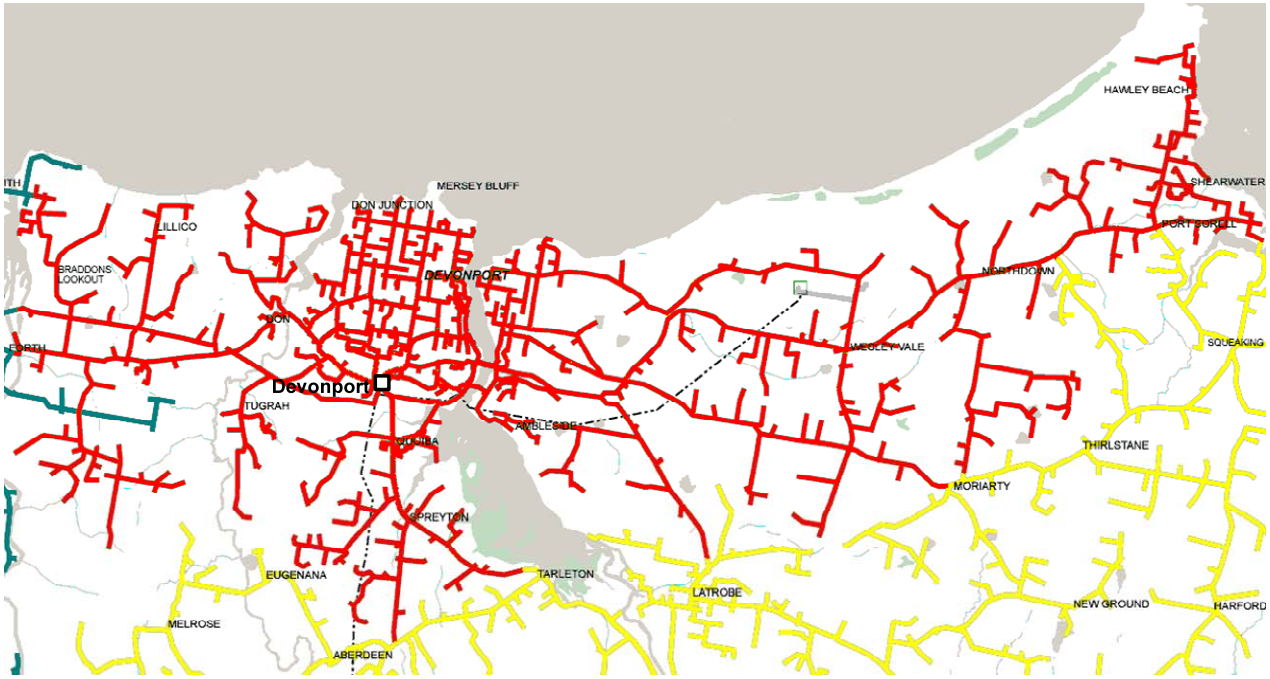


Figure 8-2 Devonport 22 kV supply area

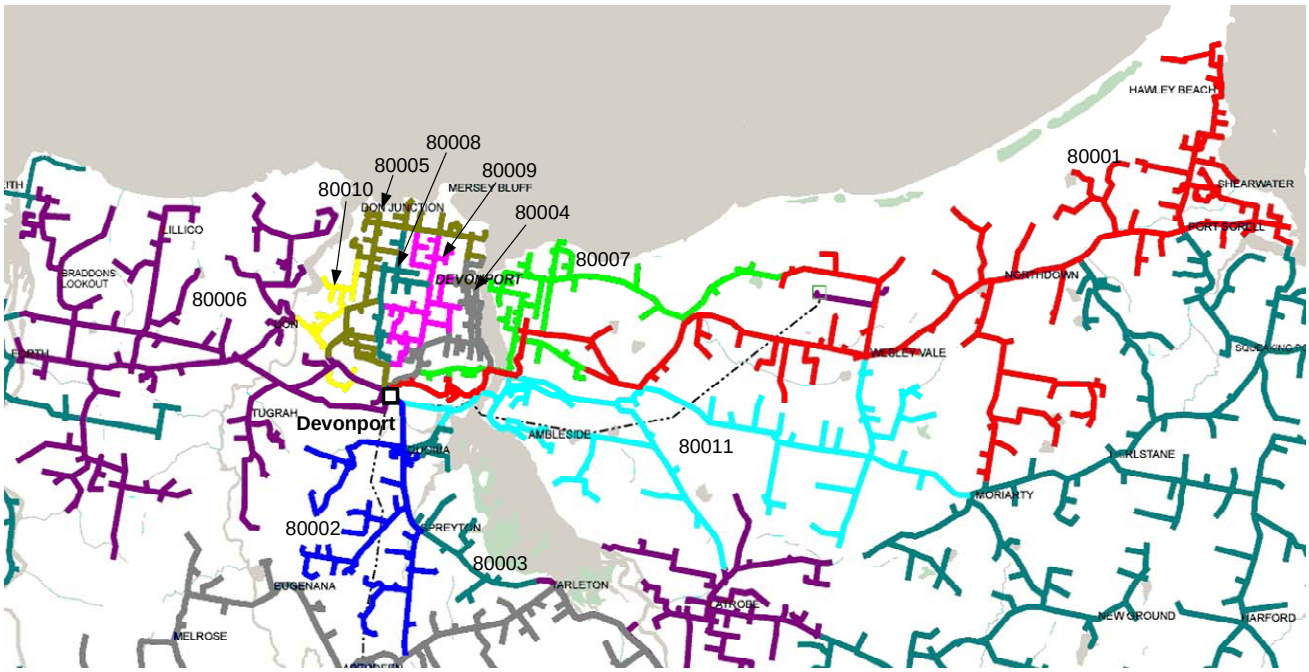


Figure 8-3 Devonport 22 kV individual feeders

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)
East Devonport	80007	7.84	7.97	8.10	8.22	8.34	8.46
	80011	2.67	2.71	2.75	2.79	2.84	2.88
Port Sorell	80001	8.58	8.72	8.85	8.99	9.12	9.25
Devonport West	80006	4.95	5.03	5.10	5.18	5.26	5.33
Devonport CBD	80004	10.85	11.02	11.20	11.37	11.53	11.70
	80005	8.09	8.22	8.35	8.47	8.60	8.72
	80008	3.92	3.98	4.04	4.10	4.16	4.22
	80009	9.41	9.56	9.71	9.86	10.00	10.15
	80010	2.59	2.64	2.68	2.72	2.76	2.80
Devonport South	80002	7.69	7.81	7.93	8.05	8.17	8.29
	80003	7.05	7.16	7.27	7.38	7.49	7.60

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 limitations are present in the Devonport CBD and to the south of the substation.

The CBD feeders 80004 and 80009 have firm capacity issues in the five year period. The adjacent CBD feeders are lightly loaded and a 22 kV feeder reconfiguration is required in the CBD to spread the load across the feeders. The two feeders running to Wesley Vale, 80007 and 80001 will be deloaded by the installation of the Wesley Vale substation in 2012. The tails from these feeders can be redirected into the CBD to provide further relief if required. Further information about the reconfiguration is provided in Section 8.1.2.

The 22 kV feeder works in the area are focused on utilising the tails from the existing Devonport feeders that are freed up with the installation of the Wesley Vale substation in 2012. There are no spare circuit breakers at Devonport so this strategy will be important to enable the capacity of the substation and the existing feeders to be fully utilised.

Devonport substation has existing transfer capability with Railton and Ulverstone. 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)
Devonport - Railton	85003	1.2	1.1	1.1	1.1	1.1	1.1
	85004	3.8	3.8	3.7	3.7	3.7	3.6
Devonport - Ulverstone	82001	4.2	4.2	4.2	4.1	4.1	4.0
Total transfers	-	9.2	9.1	9.0	8.9	8.9	8.7

The actual load at Devonport is already exceeding the firm capacity of the substation. There is reasonable transfer capability available to both the Railton and Ulverstone substations. The new Wesley Vale substation will relieve Devonport and more load transfers will become available.

8.1.2 Proposed projects

Wesley Vale substation conversion

The Wesley Vale substation is proposed to be converted to a new 110/22 kV connection point in 2012 to relieve the firm capacity limitation at Devonport and improve reliability in the Port Sorell/Hawley Beach area. For information on the options analysis for this project, please refer to ten year plan in Section 6.1.1. For information on the scope of work under the five year plan please refer to Section 8.3.

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

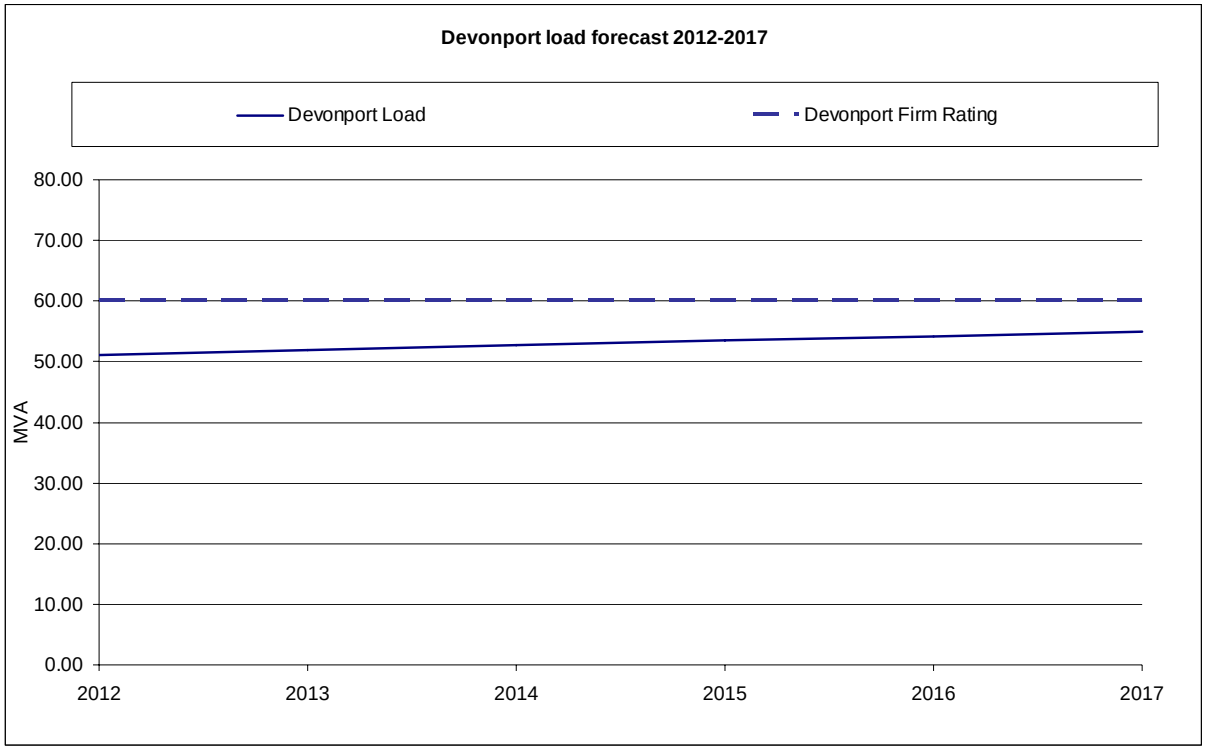


Figure 8-4 Devonport forecast with Wesley Vale substation conversion

As outlined above, Devonport load is reduced below firm capacity in 2012.

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

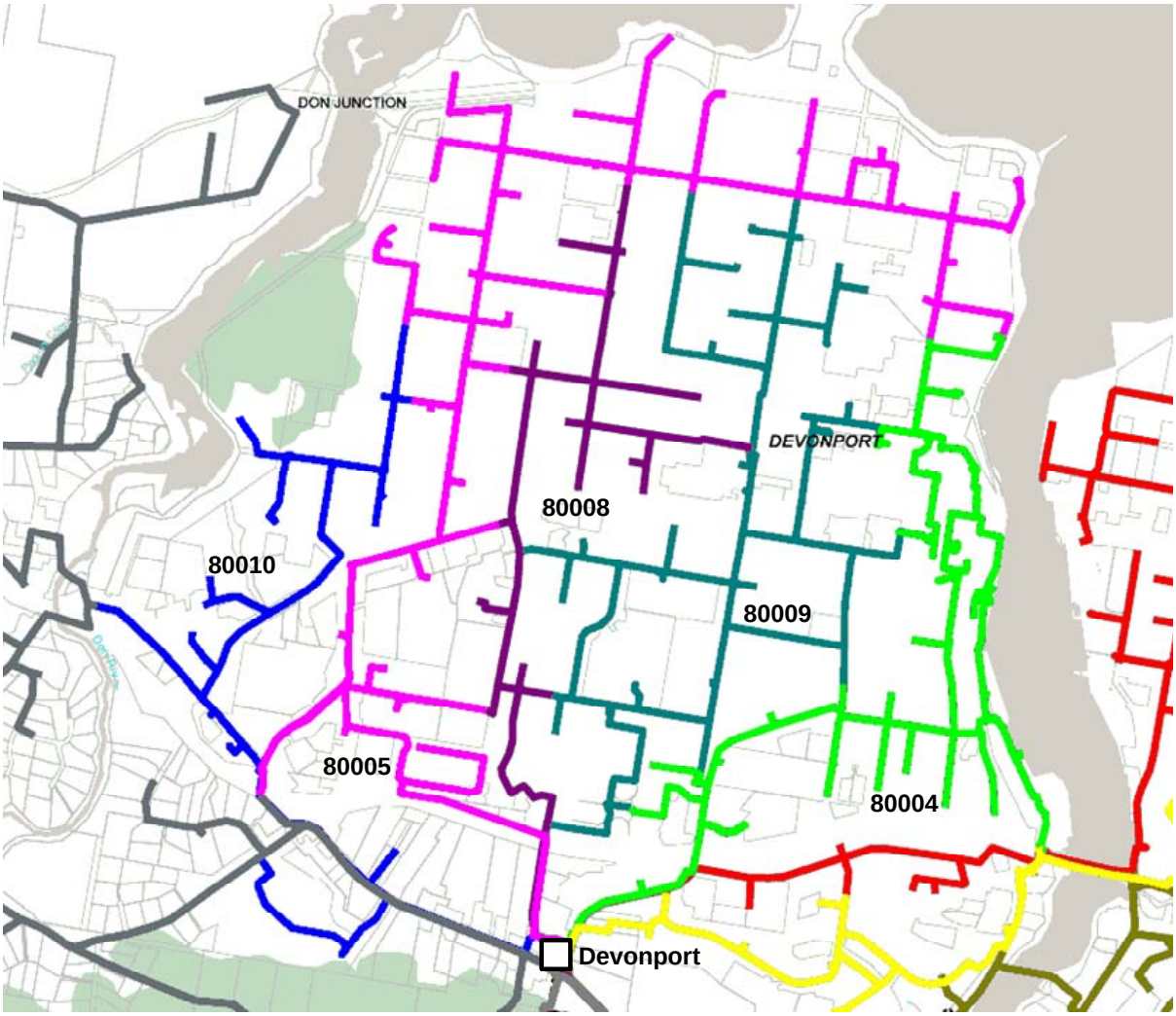
Table 8-3 Devonport substation proposed feeder forecast

Area	Feeder/s	2012 load (MVA)	2013 load (MVA)	2014 load (MVA)	2015 load (MVA)	2016 load (MVA)	2017 load (MVA)
Port Sorell	80001	0.75	0.76	0.77	0.79	0.80	0.81
East Devonport	80007	4.40	4.47	4.54	4.61	4.68	4.74
	80011	1.00	1.02	1.03	1.05	1.06	1.08

As outlined above, feeders 80001, 80007 and 80011, are deloaded by the conversion of the Wesley Vale substation. The feeder tails will be able to be redirected into the CBD and to the south of the substation as required.

CBD feeder reconfiguration

There are five 22 kV feeders supplying the CBD area of Devonport as shown in the following figure.



Two of the five feeders, 80004 and 80009, will be overloaded in the five year period. There are two lightly loaded feeders, 80008 and 80010, which have available capacity. A feeder reconfiguration is required to balance the CBD load across the feeders. 80008 is located adjacent to 80009 and a load transfer should be possible with minimal feeder works (and may include the installation of a new tie). The existing tails for 80001 and 80007 run close to the overloaded feeder 80004 and can be utilised to split the overloaded feeder after the Wesley Vale substation conversion. Utilising existing feeder tails and load transfers is expected to be a feasible minimal cost solution that will balance the load and relieve the overloaded feeders.

8.1.3 Ultimate configuration

Substation

Devonport is expected to remain a three transformer substation up to 2050. The three existing transformers will be replaced with 60 MVA units when the age limitation is reached. The conversion of the Wesley Vale substation to a new connection point delays the need to increase the capacity at the Devonport substation.

Feeders

The ultimate supply area for Devonport is predicted to include the CBD area and small areas to the west and south. With Wesley Vale substation to the east and low predicted growth in the west, it is expected that the majority of future feeders required will be in the northern direction to the CBD and the southern area towards Railton. As there are no spare circuit breakers at Devonport, it is not expected that any new feeder projects will be completed until additional switchgear is installed when the transformers are upgraded towards the end of the long term plan period. The utilisation of existing feeder tails will be very important to utilise the firm capacity of the substation.

The feeders running towards Wesley Vale, 80001 and 80007, can be redirected into the CBD to provide additional capacity to the area. The feeders to the south of the substation, 80002 and 80003, are heavily loaded throughout the five year period but do not exceed their firm rating. The feeder 80011 towards Wesley Vale will be deloaded by the installation of the Wesley Vale substation in 2012. The tail from this feeder can be redirected to the south to provide relief for the two southern feeders as required. The transfer capability of the existing Devonport feeders should be monitored and additional ties between feeders installed as required.

8.2 Railton substation

Railton terminal substation supplies the cement works adjacent to the substation and large rural areas including Deloraine and towards Port Sorell.

8.2.1 Limitations

Using the medium growth forecast, the Railton terminal substation load in 2012 is forecast to be 46.93 MVA and it is forecast to be 48.17 MVA in 2017. The load in 2010 is above the firm capacity of the substation but the recent installation of two 5 MVAr capacitor banks should reduce the peak load until the upgrade of the Wesley Vale substation which will deload Railton in 2012.

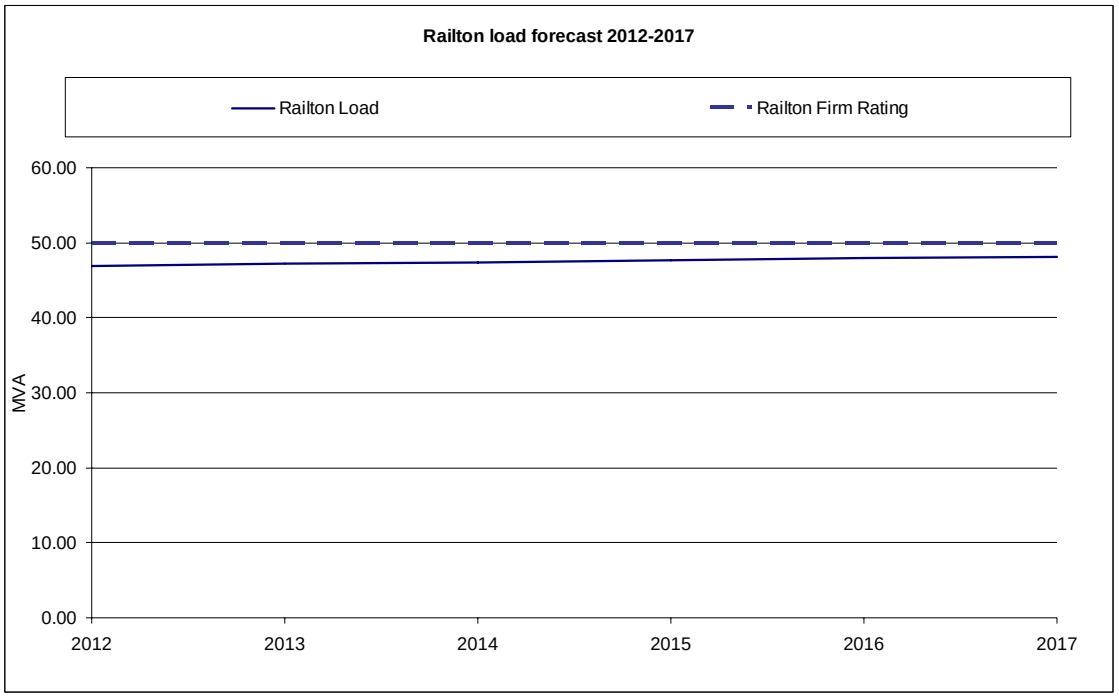


Figure 8-5 Substation five year medium growth forecast

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

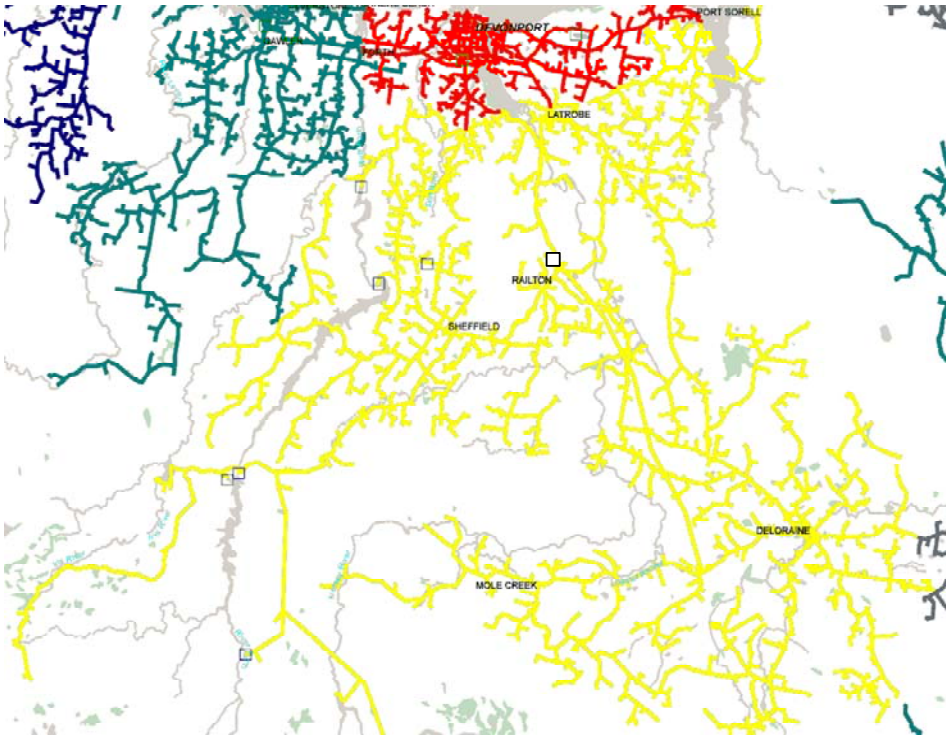


Figure 8-6 Railton 22 kV supply area

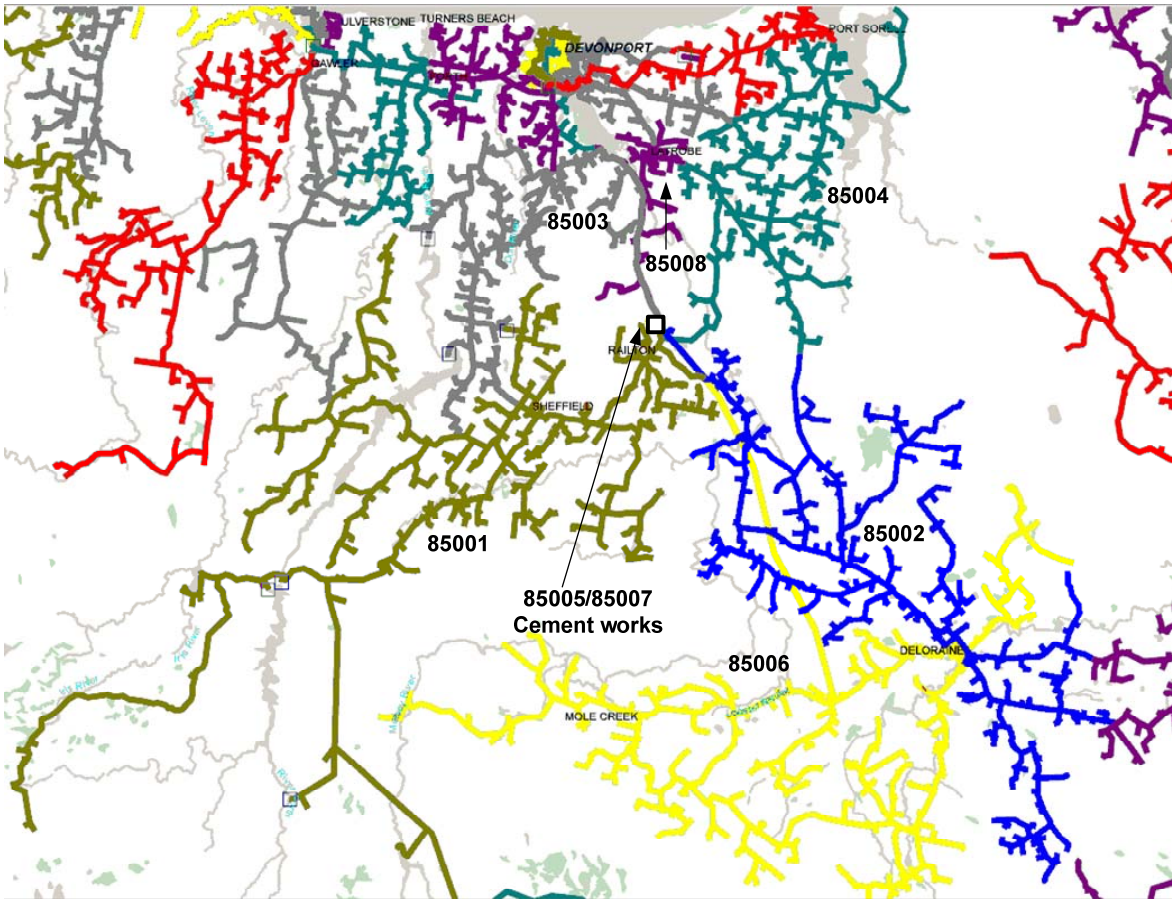


Figure 8-7 Railton 22 kV individual feeders

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 8-4 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 Sorell	85004	5.70	5.73	5.76	5.79	5.82	5.85
Deloraine	85006	6.97	7.01	7.04	7.08	7.12	7.15
	85002	6.03	6.07	6.10	6.13	6.16	6.19
North Railton	85008	7.66	7.70	7.74	7.78	7.82	7.86
	85003	3.62	3.64	3.65	3.67	3.69	3.71
Cement works	85005	11.59	11.65	11.71	11.77	11.84	11.90
	85007	14.50	14.57	14.65	14.73	14.80	14.88
South West rural	85001	6.20	6.23	6.26	6.29	6.33	6.36

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 limitations are present on the feeders to the cement works.

The average load on the two feeders to the cement works, 85005 and 85007, is approximately 10 MVA. Growth on these feeders will be dependent on a load increase at the cement works rather than a generic growth rate. Depending on customer requirements, if an additional dedicated feeder is required, the existing feeder configuration will need to be modified to free up a feeder tail from the substation. Further information is provided in Section 8.2.2.

The Deloraine feeders, 85002 and 85006, are reasonably well loaded during peak times and have reliability issues due to the length of the feeders and the large loads at the end of the feeders. The installation of the Westbury substation in 2017 will take the majority of the load on the Deloraine feeders, transferring the load to the Tamar area and deloading Railton. For information on the effect on the Railton feeders, refer to Section 8.2.2. For information on the options analysis and details on the proposed feeder configuration for Westbury substation, refer to the Tamar strategic area plan – Report 1 in the series.

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

Table 8-5 Forecast transfer capability

Substation	Feeder	2012 transfer (MVA)	2013 transfer (MVA)	2014 transfer (MVA)	2015 transfer (MVA)	2016 transfer (MVA)	2017 transfer (MVA)
Railton - Devonport	80002	3.3	3.2	3.0	2.9	2.8	2.7
	80011	6.2	6.2	6.1	6.0	6.0	5.9
Total transfers	-	9.5	9.4	9.1	8.9	8.8	8.6

There is reasonable transfer capability available to Devonport substation. The new Wesley Vale substation will relieve Railton and more load transfers will become available.

8.2.2 Proposed projects

Wesley Vale substation conversion

The Wesley Vale substation is proposed to be converted to a new 110/22 kV connection point in 2012 to relieve the firm capacity limitation at Devonport and improve reliability in the Port Sorell/Hawley Beach area. For information on the options analysis for this project, refer to ten year plan in Section 6.1.1. For information on the scope of work under the five year plan, please refer to Section 8.3.

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

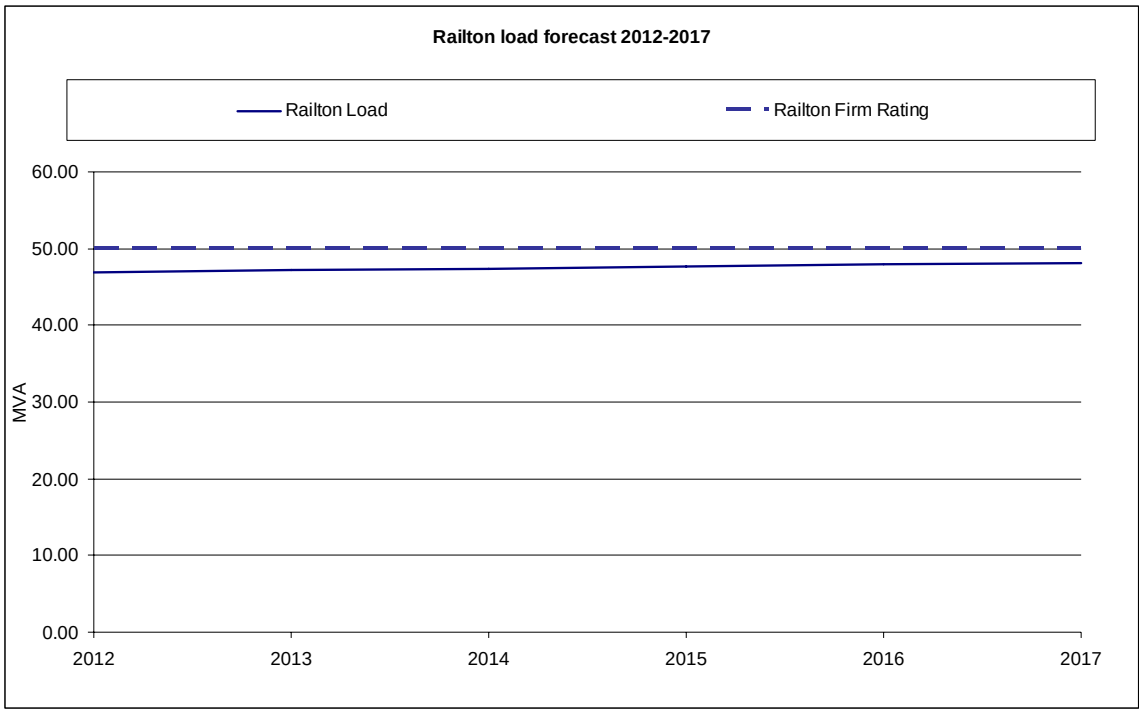


Figure 8-8 Railton forecast with Wesley Vale substation conversion

As outlined above, Railton load is reduced below firm capacity in 2012.

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

Table 8-6 Railton 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)
Port Sorell	85004	3.20	3.22	3.23	3.25	3.27	3.28
North Railton	85008	5.00	5.03	5.05	5.08	5.11	5.13

As outlined above, feeders 85004 and 85008, are deloaded by the conversion of the Wesley Vale substation. The feeder tails will be able to be redirected as required.

Westbury substation

The Westbury substation is proposed to be installed in 2017 to relieve the firm capacity limitation at Hadspen and Railton and improve reliability in the Westbury/Deloraine area. For information on the options analysis and the scope of work under the five year plan please refer to the Tamar area strategic plan – Report 1 in the series.

The resulting Railton load is reduced below firm capacity in 2017 as shown in Figure 8-9.

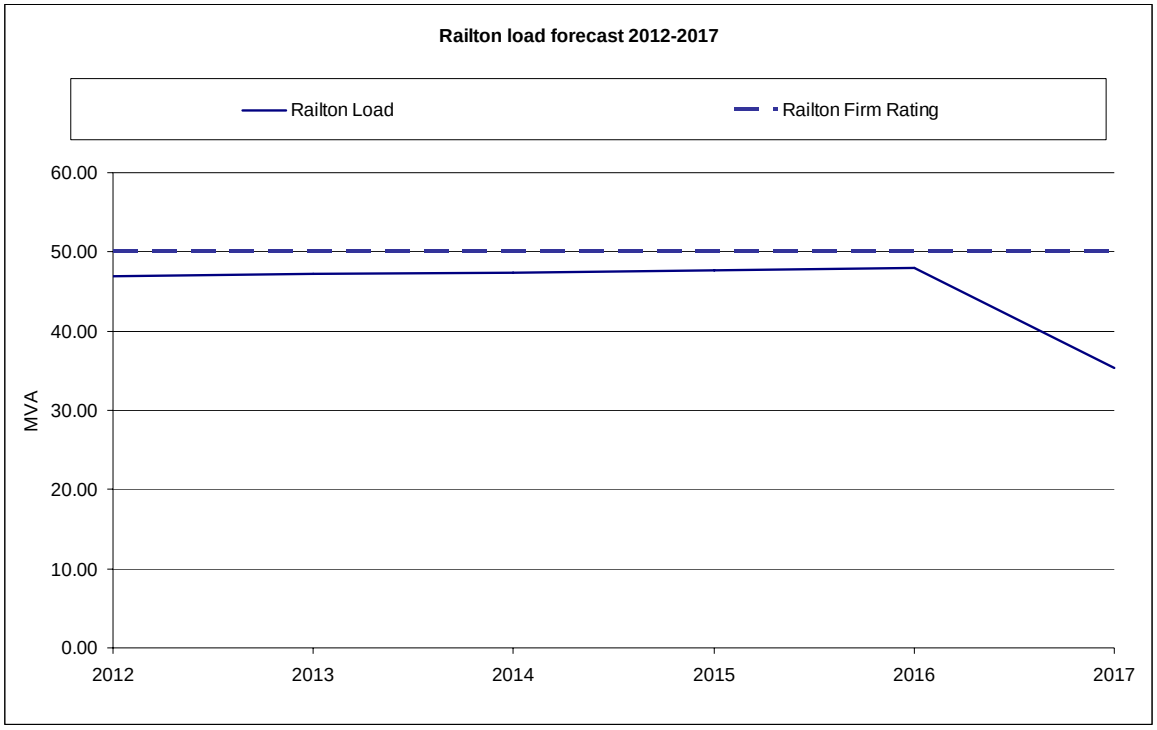


Figure 8-9 Railton forecast with the installation of Westbury substation

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

Table 8-7 Railton 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)
Deloraine	85006	7.92	7.97	8.01	8.05	8.09	0*
	85002	8.33	8.37	8.42	8.46	8.51	0.75

As outlined above, feeders 85002 and 85006 are deloaded by the establishment of Westbury substation. The feeder tails will be available for use as new feeders from Railton.

Additional feeder to the cement works

Depending on customer requirements, if an additional dedicated feeder is required, the existing Railton 22 kV feeder configuration will need to be modified to free up a feeder tail from the substation.

This may be possible with the deloading of 85004 and 85008 during the installation of the Wesley Vale substation. It may be possible to combine these feeders into one to provide a spare tail from the Railton substation. Additional support will be available to the combined feeder from the lightly loaded northern feeder 85003. If this reconfiguration is not possible, a spare feeder tail will not be available until the Deloraine feeders are deloaded by the installation of the Westbury substation in 2017.

8.2.3 Ultimate configuration

Substation

Railton is expected to remain a two transformer substation up to 2050. The two existing transformers will be replaced with 60 MVA units when the age limitation is reached. The conversion of the Wesley Vale substation to a new connection point delays the need to increase the capacity at the Railton substation.

Feeders

Due to Railton's rural location, it is not expected that many new feeders will be required into the surrounding rural areas. As noted above there are no spare circuit breakers at Railton substation. The utilisation of existing feeder tails will be very important to utilise the firm capacity of the substation.

8.3 Wesley Vale substation

The Wesley Vale substation is proposed to be installed in 2012 to relieve the firm capacity limitations at Devonport and improve reliability in the Port Sorell/Hawley Beach area. For information on the options analysis for this project, please refer to the ten year plan in Section 0. This section of the report will focus on the scope of work for Aurora under the five year plan.

Using the current site location, the scope of works for this project includes:

- Installation of a 600 m 22 kV underground cable to cut into Devonport feeder 80007 on Mill Road. This feeder will pick up load from Devonport feeders 80007 and 80001.
- Installation of a 1.1 km 22 kV underground cable to cut into Devonport feeder 80001 on Mill Road. This feeder will pick up load from Devonport feeder 80001.
- Installation of a 2.5 km 22 kV underground cable to cut into F 85008 on Wesley Vale Road. This feeder will pick up load from Railton feeders 85004 and 85008 and from the Devonport feeder 80011
- Installation of a 22/11 kV transformer to supply Dim furniture. The transformer location will be determined during discussion with the customer.

The proposed works and the feeder supply areas are shown in the following figures.

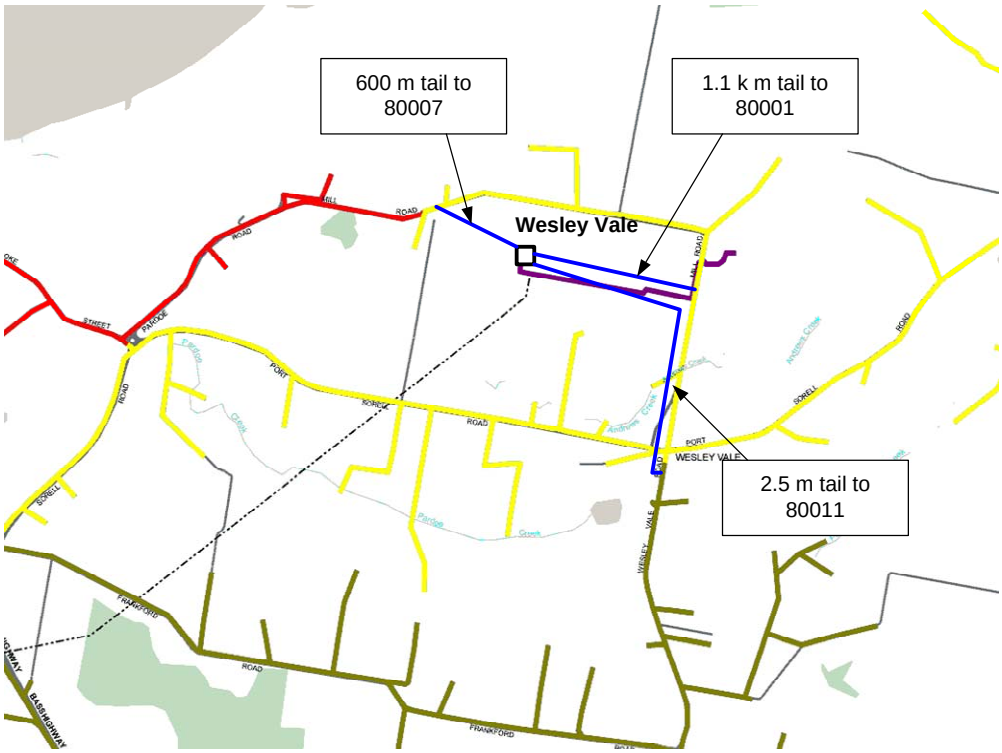


Figure 8-10 Wesley Vale substation 22 kV feeder works

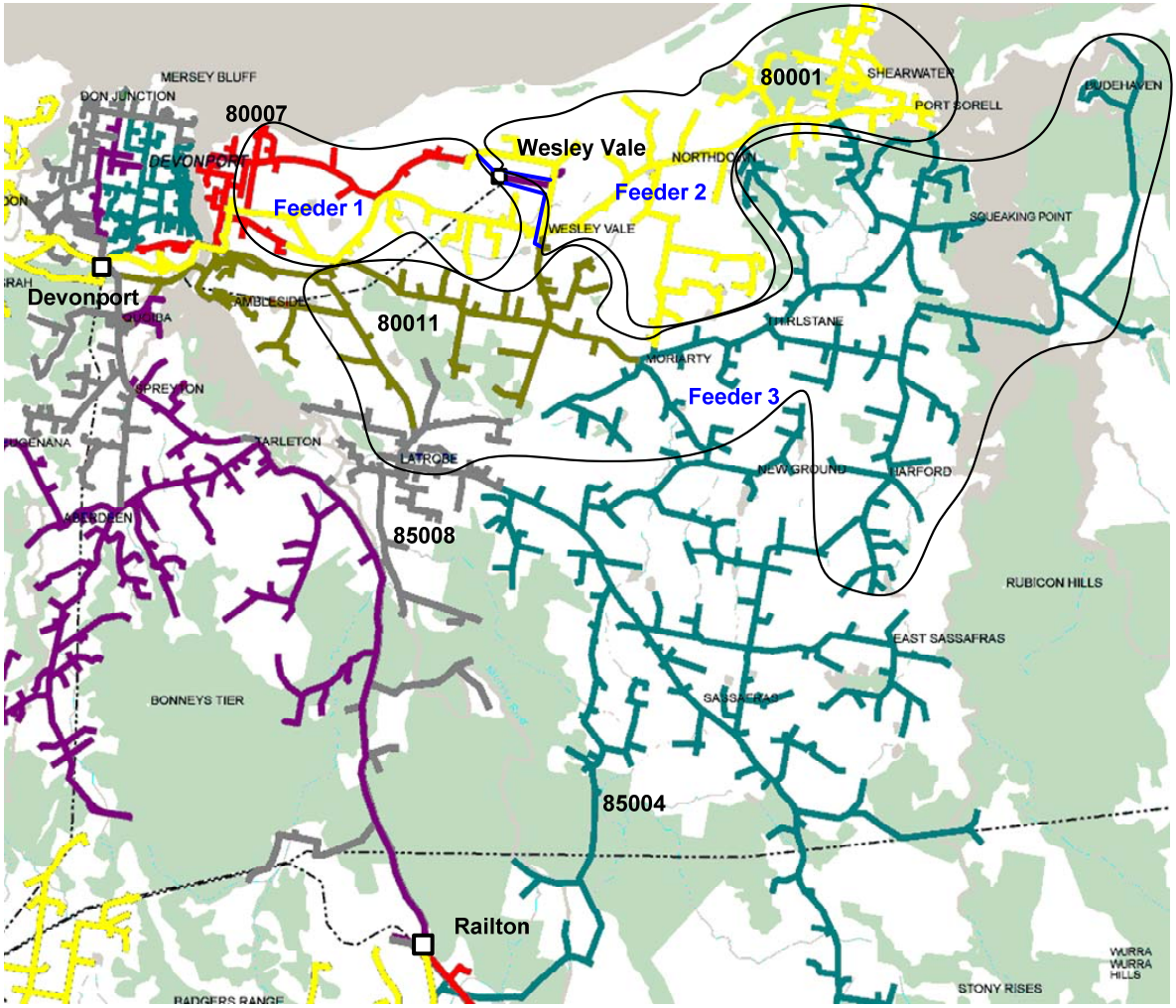


Figure 8-11 Wesley Vale substation new approximate 22 kV feeder supply areas

DINIS has been used to calculate approximate feeder loads for the new feeders from the Wesley Vale substation. Further analysis will be required on the final 22 kV configuration when the planning is completed.

Table 8-8 Proposed new feeder growth

Area	Feeder/s	2017 load (MVA)	2018 load (MVA)	2019 load (MVA)	2020 load (MVA)	2021 load (MVA)	2022 load (MVA)
Wesley Vale	1	4.00	4.06	4.13	4.19	4.25	4.31
	2	6.20	6.30	6.40	6.50	6.59	6.69
	3	6.30	6.40	6.50	6.60	6.70	6.79

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

8.3.1 Proposed projects

The Wesley Vale substation is to be converted in the first year of the five year plan period so there are no further projects required for this substation supply area.

8.3.2 Ultimate configuration

Substation

Wesley Vale is expected to remain a two transformer substation up to 2050. The transformers are due for replacement in 2021 due to firm capacity issues and predicted age limitations. The installation of 60 MVA units will dramatically increase the firm capacity of the substation and the area.

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	Wesley Vale substation conversion	7.1.1

Wesley Vale NPV analysis (North Coast area)

Base Year

2010

OPTION 1

Conversion of Wesley Vale substation

Development Year			System Limitation	Description of Works		Medium Growth Net Present Value in $ M			High Growth Net Present Value in $ M			Low Growth Net Present Value in $ M		
Medium	High	Low			Cost $k	5.64%	6.64%	7.64%	5.64%	6.64%	7.64%	5.64%	6.64%	7.64%
2012	2011	2013	Devonport and Railton system capacity exceeded	Convert Wesley Vale to 110/22 kV - 22 kV feeder cut-ins and transformer at factory	$1,200	$1.08	$1.06	$1.04	$1.14	$1.13	$1.11	$1.02	$0.99	$0.96
2021	2020	2022	Wesley Vale transformer age limitation	Transformer replacement at Wesley Vale - 2 x 110/22 kV 60 MVA transformers	$6,000	$3.28	$2.96	$2.67	$3.47	$3.15	$2.87	$3.11	$2.77	$2.48
2046	2045	2047	Devonport transformer age limitation	Transformer replacement at Devonport - Replace 3 x 110/22 kV 60 MVA transformers	$11,700	$1.62	$1.16	$0.83	$1.71	$1.23	$0.89	$1.54	$1.08	$0.77
					Total	**$5.98**	**$5.17**	**$4.53**	**$6.32**	**$5.51**	**$4.88**	**$5.66**	**$4.85**	**$4.21**

OPTION 2

Replacement of the Devonport transformers

Development Year			System Limitation	Description of Works		Medium Growth Net Present Value in $ M			High Growth Net Present Value in $ M			Low Growth Net Present Value in $ M		
Medium	High	Low			Cost $k	5.64%	6.64%	7.64%	5.64%	6.64%	7.64%	5.64%	6.64%	7.64%
2012	2011	2013	Devonport and Railton system capacity exceeded	Transformer replacement at Devonport - Replace 3 x 110/22 kV 60 MVA transformers	$11,700	$10.48	$10.29	$10.10	$11.08	$10.97	$10.87	$9.92	$9.65	$9.38
2021	2020	2022	Wesley Vale transformer age limitation	Transformer replacement at Wesley Vale - 2 x 110/22 kV 60 MVA transformers	$7,200	$3.94	$3.55	$3.20	$4.16	$3.79	$3.45	$3.73	$3.33	$2.98
					Total	**$14.42**	**$13.84**	**$13.30**	**$15.23**	**$14.76**	**$14.32**	**$13.65**	**$12.98**	**$12.36**

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

aurecon

Aurecon
Queensland Head Office

32 Turbot Street
(Locked Bag 331, Brisbane QLD 4001)
Brisbane QLD 4000
Australia

T +61 7 3173 8000
F +61 7 3173 8001
E brisbane@ap.aurecongroup.com

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www.aurecongroup.com