# Central Area Development Plan

## Table of Approvals

<table>
<thead>
<tr>
<th>REV NO.</th>
<th>DATE</th>
<th>REVISION DESCRIPTION</th>
<th>APPROV</th>
<th>PREPARED BY</th>
<th>REVIEWED BY</th>
<th>APPROVED BY</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Original Issue</td>
<td></td>
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1. EXECUTIVE SUMMARY

The Central area is characterised by low customer density but requiring a widespread rural system to service its customers. In general terms the individual substations have power transformers typically 5 MVA and below.

It has rugged terrain, which is frequently inaccessible during winter storms. This area once required significant investment in substations and general infrastructure to meet the capacity and reliability requirements. Now the general highlands area has small loads but with significant tourist and economic industries, for example a fingerling hatchery at Wayatinah.

The growth for these areas is now generally low and as such requires little investment to meet capacity criteria. The compelling issues are now of reliability and security.

To facilitate the current and forecast load, the Central planning area maintains a distribution network at 22 kV and 11 kV, incorporating a number of local distributing zone substations. The network supplies 9,591 connected customers supplied by 4 11 kV substations and 8 22 kV substations. A total of 1,876 km of OH and UG circuit distribution network at 11 and 22 kV supplies the area.\(^1\)

The identified or known large constraints are as follows:

- Wayatinah and New Norfolk are aged substations with severely deteriorated transformers and general infrastructure.
- Gretna and Westerway are small rural zones supplying the local district at 11 kV. These stations have severely deteriorated transformers. Analysis has shown that it is uneconomic to replace them. Their respective 11 kV distribution networks will be augmented to 22 kV thus allowing these minor stations to be removed. The primary drivers for undertaking this program are aged replacement of the zone equipment and the network constraints associated with limited interconnectibility with the adjacent 22 kV distribution network.
- Derwent Bridge provides ongoing challenges with supply security. This area has significant tourist industry. Derwent Bridge is a single transformer station. The station does not meet Transend criteria for a second transformer. Thus, any maintenance on the transformer or its circuit breaker causes system difficulty. It has been general practice to provide firm support by mobile generation. There are minor issues of voltage stability and generator connection.
- Oatlands and surrounding areas continue to exhibit signs of reliability stress. Whilst being adequately backed up from three separate stations;

\(^1\) Data available in NW-#30146137-Feeder Data for Development Plans.
Meadowbank, Avoca and Sorell, some ongoing reliability issues give cause for concern.

- The areas around Kempton and Melton Mowbray have overloaded feeders and acknowledged high voltage power quality problems. In general this area is being seen as having significant potential for irrigation, e.g. Clyde Irrigation Project, and as a consequence high use of electric water pumping. This network voltage is 11 kV, which is particularly intolerant to large motor starting which gives rise to ongoing power quality issues.

- Tungatinah will have potential security issues. Transend is proposing in its rebuild of this station to replace the two units with a single unit. This will give rise to concerns with the areas security. Aurora does not have mobile generation capability to match the load profile.

To address the above constraints the following is being proposed:

- Gretna, Westerway and Hamilton analyses have shown that it is not warranted to replace these stations like for like. Their respective 11 kV distribution networks are to be augmented to 22 kV thus allowing these minor stations to be decommissioned.

- Wayatinah substation is to be replaced in 2009/10 at a budget cost of $2.9M.

- New Norfolk substation is to be replaced by 2010/11 at a budget cost $3.5M. Of note this will be using ex Sandy Bay and East Hobart power transformers to defer costs.

- At Derwent Bridge minor expenditure to provide a ‘plug in’ generator connection is planned in 2009/10 along with minor augmentation to manage the unsymmetrical load.

- For Oatlands, a Targeted Reliability Improvement Program (TRIP) will commence in 2009/10 with commissioning in 2010/11.

- The areas of Melton Mowbray and north of Kempton will be progressively augmented from 11 kV to 22 kV and transferred to Meadowbank supply. The first stage, new connection at 22 kV, near Bothwell, is nearly complete with further 11/22 kV augmentations to be constructed in 2009/10 at a budgeted cost of $300k. There will be further work, possibly in 2010/12, to complete the conversion. This work has a conceptual cost of $400 k. This will also have the benefit to reduce load on Bridgewater Substation and in particular feeder 48190.

- Further discussions are being held with Transend as to the feasibility of a second transformer at Tungatinah. Investigations are being conducted into the acquisition of a mobile generator of sufficient size as an alternative option.
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2. EXISTING SYSTEM

2.1 Substations

The Central planning area has a number of Transend owned Injections Points and Aurora owned substations as follows:

Note: hyperlinks in the section below will display the power circuit one line diagram from Transend’s Operational Diagram System.

**Transend owned substations**

- Arthur’s Lake – ([click here to see the 110 / 6.6 kV single line diagram](#))
- Derwent Bridge - *(110 / 22kV)*
- Meadowbank – *(110 / 22kV)*
- Tungatinah - *(110 / 22kV)*
- Waddamana - *(single line diagram not available electronically)*
- New Norfolk 22 kV – *(110/ 22kV)*

**Aurora owned substations**

- Gretna Zone
- Hamilton Zone
- Todd’s Corner Zone
- Wayatinah Zone
- Westerway Zone. – nomenclature for distributed zone substations
- New Norfolk Zone 11 kV

**Hydro Tasmania owned substations**

- Gordon
- Wayatinah station

**Embedded Generators**

- Tod’s Corner

2.2 Supply Network

There is a mixture of distribution voltages within this planning area. The terminal substations within the Central area have 22 kV distribution networks, with the exception of Arthur’s Lake, which supplies a pump station at 6.6 kV.
The zone substations have 11 kV distribution networks, with the exception of Tod’s Corner and Wayatinah. This poses reliability issues due to the difficulty of transferring load between the interspersed 11 kV and 22 kV networks, as well as transferring load with between neighbouring planning areas.

Wayatinah takes supply at 11 kV from local hydro generation and steps up to 22 kV for distribution.

Tod’s Corner is supplied from a 1.6 MVA 6.6 kV generator which recovers energy from the water pumped from Arthur’s Lake pump station. This generator only operates while Arthur’s Lake is pumping, and it generates into Arthur’s Lake terminal substation station through a 6 km 6.6 kV feeder.

2.3 Network Statistics

Central area network statistics

<table>
<thead>
<tr>
<th>Network</th>
<th>Circuit Length</th>
<th>Number of Customers</th>
<th>Connected Transformer Capacity</th>
<th>Customer Density</th>
<th>Transformer Capacity Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>11kV</td>
<td>300 km</td>
<td>2,895</td>
<td>41,310 kVA</td>
<td>10 per 11kV circuit km</td>
<td>138 kVA per 11kV circuit km</td>
</tr>
<tr>
<td>22kV</td>
<td>1,576 km</td>
<td>6,696</td>
<td>130,806 kVA</td>
<td>4 per 22kV circuit km</td>
<td>83 kVA per 22kV circuit km</td>
</tr>
</tbody>
</table>

Data sourced from Gtech, query DISTFDR. See NW-#30146137-Feeder Data for Development Plans.
The maps below show the geographic area referred to as Central.
Central Development Plan

3. LOCAL PLANNING ISSUES

3.1 Long Term System Strategy

Central planning area will continue the development of a 22 kV distribution network and an 11 kV distribution network where it is economic. Where existing 22/11kV zone substations reach their end of life, conversion of the 11kV networks to 22kV and retirement of the zone substation will be considered.

The existing distribution arrangement of both 11 kV and 22kV distribution networks will co-exist for the foreseeable future.

Embedded Generation options will be encouraged where technically feasible at 22, 11 kV and 433V connection points.

Demand Side Management solutions will be encouraged to reduce system peaks and defer large system upgrades where possible.

3.2 Local Government Authorities

The Central planning area encompasses the.

For planning purposes, Aurora consults closely with the following local government authorities in the Central planning area:

- Central Highlands Council
- Northern Midlands Council
- Southern Midlands Council and
- Derwent Valley Council

The joint land use planning strategy for all four councils implies that growth will be via infill and surrounding existing infrastructure.

Other relevant authorities include:

- Department of Infrastructure, Energy and Resources (DIER); and
- Southern Water Tasmania.

3.3 Existing Critical Loads

Central planning area has a small number of existing critical loads requiring a higher level of supply security or a limit to operational flexibility. Table 1 below details critical loads in the Central planning area:
<table>
<thead>
<tr>
<th>Load Type</th>
<th>Description</th>
<th>Substation(s)</th>
<th>Feeder(s)</th>
<th>Asset Connection Point(s) - if applicable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial / Major Retail</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medical</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rehabilitation Services</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Industrial</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sewerage Treatment Plants</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 – Central Critical Loads

Improvements to supply security for the above connections and supply areas are encouraged.

3.4 Future Developments and Restrictions

- Council planning schemes
- Irrigation systems

3.5 Reliability for the area.

The Central Planning Area includes the following Reliability communities:

- Urban - New Norfolk
- High Density Rural - Brighton Rural, Granton – Magra, Oatlands, Wayatina
- Low Density Rural – Bothwell, Derwent Valley Rural, Highlands

Details of actual reliability performance in the 09/10 financial year are available in here. (DM ref# 30061377)

On figures for the 8 months to February 2010 the following communities appear likely to have reliability performance worse than target in 2010:

- Bothwell SAIDI and SAIFI
- Highlands SAIDI
• Oatlands SAIFI
The reliability communities in the Central Planning area have shown adequate reliability performance in 2009/10 up to February 2010.

3.6 Asset issues

There are a number of asset issues throughout the central area. Zone substation transformers are at or beyond their nominal end of life or in poor condition at the following zone substations:

• Gretna
• Hamilton
• Westerway
• Wayatinah
• New Norfolk

Further information is detailed in the following Asset Management Plans relevant to the HE planning area:

NW30084385 - Management Plan 2010: Ground Mounted Substations
NW30070052 - Management Plan 2010: High Voltage Regulators
NW30084411 - Management Plan 2010: Overhead System and Structures
NW30043361 - Management Plan 2010: Underground System
NW30084386 - Management Plan 2010: Zone Substations

3.7 Links

LAM Area Management Plans relevant to the Central planning area are:

• Highlands NW-#229385-Area Management Plan Highlands 09
• Midlands South NW-#164938-Area Management Plan Midlands South
• Midlands North NW-#226271-Area Management Plan Midlands North

In addition Transend’s Annual Planning Report contains relevant information. It can be found on their website www.transend.com.au.
4. LOAD FORECAST

- The 2009 10 year load forecast report by UES is used as the basis for this plan. NW-#30083791-(pdf version) Aurora 2009 10year Load forecast - Draft
- Connected kVA (from Web map) customer connections
- Description

Forecast load growth tables are stored in the spreadsheet NW-#30040697-Zone and Area MD and consumption tables 2009

<table>
<thead>
<tr>
<th>Planning Area</th>
<th>Connection Point Substation</th>
<th>Forecast Growth p.a.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>Arthurs Lake</td>
<td>N/A</td>
</tr>
<tr>
<td>Central</td>
<td>Derwent Bridge</td>
<td>0.9%</td>
</tr>
<tr>
<td>Central</td>
<td>Gordon</td>
<td>4.8%</td>
</tr>
<tr>
<td>Central</td>
<td>Meadowbank</td>
<td>3.7%</td>
</tr>
<tr>
<td>Central</td>
<td>New Norfolk</td>
<td>1.9%</td>
</tr>
<tr>
<td>Central</td>
<td>Tungatinah</td>
<td>3.2%</td>
</tr>
<tr>
<td>Central</td>
<td>Waddamana</td>
<td>4.2%</td>
</tr>
<tr>
<td>Central</td>
<td>Wayatinah</td>
<td>3.0%</td>
</tr>
</tbody>
</table>

Although the table above shows relatively high forecast load growth, these are all from a low base. The long term plan for the area addresses projected capacity constraints at Meadowbank and New Norfolk. The other substations in the Central area are not expected to meet capacity constraints in the long term planning horizon till 2050.

Copy of load profile

4.1 Future committed point loads (> 1 MVA)
- None identified

4.2 Possible point loads (> 1 MVA)
  - None identified

4.3 Possible point loads to be removed (> 1 MVA)
- None identified
4.4 Possible future embedded generation (> 1 MVA)

- None identified

4.5 Analysis of Load Forecast

Detailed load forecast data is available in the following documents:

- Load model hyperlink / reference NW-#30069003-Central area load model (2009)
- Copy of load forecast graph NW-#30083791-(pdf version) Aurora 2009 10year Load forecast - Draft

![Highlands Region MD Load Forecast Graph](attachment:image)
5. PLANNING CRITERIA

Aurora’s Distribution Network Planning Manual issued in May 1999 is available in DM, ref NW10250570.

More up to date information is included in this document in Appendix E on page 38.

6. CONSTRAINTS (LIMITATIONS)

Constraints in the Central planning area are classified under the following management groups:

<table>
<thead>
<tr>
<th>Constraint</th>
<th>Description</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>Substation Firm Capacity</td>
<td>Substation Maximum Demand &gt; Substation Firm Capacity (N-1)</td>
</tr>
<tr>
<td></td>
<td>Feeder Tail Capacity</td>
<td>Feeder Maximum Demand &gt; 5 MVA for 11 kV OR 10 MVA for 22 kV</td>
</tr>
<tr>
<td></td>
<td>Feeder Section Capacity</td>
<td>Load through conductor &gt; conductor continuous rating</td>
</tr>
<tr>
<td></td>
<td>Feeder Tie Capacity</td>
<td>Transfer Capacity limited due to undersized conductor/equipment</td>
</tr>
<tr>
<td>Fault Level</td>
<td>Substation Bus Fault Level</td>
<td>Maximum 3-phase fault level &gt; 13.1 kA OR Maximum 1-phase &gt; XX.X kA</td>
</tr>
<tr>
<td></td>
<td>Equipment Rating Fault Level</td>
<td>Maximum 3-phase OR 1-phase fault level &gt; equipment rating</td>
</tr>
<tr>
<td></td>
<td>Normal load Voltage Drop</td>
<td>Voltage drop exceeds ± 6%</td>
</tr>
<tr>
<td></td>
<td>Emergency load Voltage Drop</td>
<td>Voltage drop exceeds ± 10%</td>
</tr>
<tr>
<td>Reliability</td>
<td>SAIDI</td>
<td>Reliability community SAIDI performance has or is likely to exceed target</td>
</tr>
<tr>
<td></td>
<td>SAIFI</td>
<td>Reliability community SAIFI performance has or is likely to exceed target</td>
</tr>
</tbody>
</table>

Table 2 - Constraint Definitions

Constraints are managed at the following levels

- Zone Substation
- Subtransmission Feeder
- Distribution Feeder
- Distribution Substation
- LV Systems

This document details constraints at the Zone Substation (inc Rural Zone Substations), Subtransmission Feeder and Distribution Feeder levels only. Refer to XXXXXXXXXX for State wide management plans for the Distribution Substation and LV System planning levels
### Summary of Constraints

#### 6.1.1 Zone Substation Constraints

<table>
<thead>
<tr>
<th>Substation</th>
<th>Firm Capacity (MVA)</th>
<th>Current Load (MVA)</th>
<th>Forecast to exceed (year)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gretna</td>
<td></td>
<td></td>
<td></td>
<td>Operational &amp; Aged assets: Rural Zone 22/11kV in poor condition</td>
</tr>
<tr>
<td>Westerway</td>
<td></td>
<td></td>
<td></td>
<td>Operational &amp; Aged assets: Rural Zone 22/11kV in poor condition</td>
</tr>
<tr>
<td>Derwent Bridge</td>
<td></td>
<td></td>
<td></td>
<td>Security: Single transformer substation</td>
</tr>
</tbody>
</table>

### Fault Level Constraints

<table>
<thead>
<tr>
<th>Substation</th>
<th>Fault Level Description</th>
<th>Forecast replacement (year)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>None identified</td>
</tr>
</tbody>
</table>
### 6.1.2 Subtransmission Constraints

#### Capacity Constraints

<table>
<thead>
<tr>
<th>Substation</th>
<th>Feeder</th>
<th>Capacity constraint type</th>
<th>Forecast to exceed (year)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

#### Voltage Constraints

<table>
<thead>
<tr>
<th>Substation</th>
<th>Feeder</th>
<th>Forecast to exceed (year)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>None identified</td>
<td></td>
</tr>
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</table>

#### Reliability Constraints

<table>
<thead>
<tr>
<th>Substation</th>
<th>Feeder</th>
<th>Forecast to exceed (year)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>None identified</td>
<td></td>
</tr>
</tbody>
</table>
### 6.1.3 Distribution Feeder Constraints

#### Capacity Constraints

<table>
<thead>
<tr>
<th>Substation</th>
<th>Feeder</th>
<th>Capacity constraint type</th>
<th>Forecast to exceed (year)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meadowbank</td>
<td>45002</td>
<td>Feeder Section</td>
<td>Already Exceeding</td>
<td>Lake Crescent SWER</td>
</tr>
</tbody>
</table>

#### Voltage Constraints

<table>
<thead>
<tr>
<th>Substation</th>
<th>Feeder</th>
<th>Forecast (year)</th>
<th>to exceed</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bridgewater</td>
<td>48190</td>
<td>Already exceeding</td>
<td></td>
<td>11kV feeder voltage and power quality problems near Kempton</td>
</tr>
</tbody>
</table>

#### Reliability Constraints

<table>
<thead>
<tr>
<th>Substation</th>
<th>Feeder</th>
<th>Forecast (year)</th>
<th>to exceed</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None identified</td>
</tr>
</tbody>
</table>
6.2 Security

Aurora’s zone substations are typically run in N-1 secure mode. This means that in the event of any single outage of a network element all load can still be supplied. Due to the low load in the Central area, in many cases the extra expense required to provide for N-1 secure operation cannot be justified.

- Derwent Bridge provides ongoing challenges with supply security. This area has significant tourist industry. Derwent Bridge is a single transformer station. The station does not meet Transend criteria for a second transformer. Thus, any maintenance on the transformer or its circuit breaker causes system difficulty. It has been general practice to provide firm support by mobile generation. There are minor issues of voltage stability and generator connection.

- Wayatinah and New Norfolk are aged substations with severely deteriorated transformers and general infrastructure.

- Tungatinah will have potential security issues. Transend is proposing in its rebuild of this station to replace the two units with a single unit. This will give rise to a lower security. Aurora do not have mobile generation capability to match the load profile.

6.3 Transfer and Operational Capability

The table below shows the rating, peak load and transfer capacity. The peak load figures are those forecast for winter 2010. Since Aurora’s substations are subject to winter peaks, these are the most onerous.

<table>
<thead>
<tr>
<th>Substation</th>
<th>Rating</th>
<th>N-1 Rating</th>
<th>Peak Load</th>
<th>Transfer Capacity</th>
<th>Transfer Substation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meadowbank</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Norfolk</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The table shows that...

Details of the analysis carried out on load transfers in the Central area are available in.
• Operational requirements Gretna and Westerway are small rural zones supplying the local district at 11 kV. These stations have severely deteriorated transformers. Analysis has shown that it is uneconomic to replace them. Their respective 11 kV distribution networks will be augmented to 22 kV thus allowing these minor stations to be removed. The primary drivers for undertaking this program are aged replacement of the zone equipment and the network constraints associated with limited interconnectibility with the adjacent 22 kV distribution network.

6.4 Power Factor

6.5 LV issues

The Great lake shack areas has widespread low voltage issues due to load growth and system configuration.

The table below shows the count of transformers in the planning area and the count of those that are at risk of overloading. This is determined by the count of connected customers indicated a load greater than 130% of nameplate rating. It should be noted that the actual load on a transformer may be much different to its value calculated in this way.

<table>
<thead>
<tr>
<th>Tx size</th>
<th>Total Count</th>
<th>Customer Count</th>
<th>&gt;130% of rating Count</th>
<th>Customer Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 50 kVA</td>
<td>1,178</td>
<td>2,263</td>
<td>32</td>
<td>221</td>
</tr>
<tr>
<td>&gt;= 50 kVA</td>
<td>861</td>
<td>7,120</td>
<td>16</td>
<td>798</td>
</tr>
</tbody>
</table>

7. SHORT TERM PLAN (<5YR)

The Central Area Strategic Plan provides the background to much of the planning information in this document. It can be found at: NW-#30141787-Central strategic plan Rev 5_2010 final report.

A summary of the proposed works from 2010 to 2015 in the Central planning area is outlined in the following table.

<table>
<thead>
<tr>
<th>Year</th>
<th>Proposed Project</th>
<th>Proposed Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>Arthurs Lake Transformer replacement by Transend</td>
<td>Existing single phase transformers at end of life to be replaced</td>
</tr>
</tbody>
</table>

\(^3\) Data sourced from NW-#30075639-Statewide Distribution Transformers Customer Count Nov 09. Transformer data extracted from Gtech in November 2009.
8. MEDIUM TERM PLAN (5 TO 10YR)

The Central Area Strategic Plan provides the background to much of the planning information in this document. It can be found at: [NW-#30141787-Central strategic plan Rev 5_2010 final report](#).

A summary of the proposed works between 2016 and 2020 in the Central planning area is outlined in the following table.

<table>
<thead>
<tr>
<th>Year</th>
<th>Proposed Project</th>
<th>Proposed Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>None identified</td>
<td>None identified</td>
</tr>
</tbody>
</table>

9. LONG TERM PLAN (10YR+)

The Central Area Strategic Plan provides the background to much of the planning information in this document. It can be found at: [NW-#30141787-Central strategic plan Rev 5_2010 final report](#).

A summary of the proposed works beyond 2020 in the Central planning area is outlined in the following table.

<table>
<thead>
<tr>
<th>Year</th>
<th>Proposed Project</th>
<th>Proposed Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2023</td>
<td>Install second transformer at Meadowbank</td>
<td>Increase firm capacity at Meadowbank</td>
</tr>
<tr>
<td>2029</td>
<td>Replace New Norfolk 110/11kV transformers at end of life</td>
<td>May involve upgrading 11kV distribution network to 22kV</td>
</tr>
</tbody>
</table>

Further details of these and other potential long term projects in the Central area are discussed in Appendix C below.
10. PROGRAM OF WORK DRAFT

11. OPERATIONAL PLANS

- Contingency plans (not at operational level)

Operations Group have developed a number of contingency plans to define operational actions to be taken in the event of substation, busbar and feeder outages. The document NW-#30126392-Contingency Plan Register provides links to contingency plan documents as they are produced.

12. REFERENCE DOCUMENTS

- Listing of DINIS personal files
- Links to other work documents
13. **NOTES**

- System development plans identified for the area should link to other plans. Consultation with other work groups, in particular System Performance, Distribution Operations, Area Managers and key external stakeholders eg Councils and Government Departments, is essential to ensure optimum outcomes.

- It would be useful to include any details of reference documents and schematic diagrams indicating current substation layout and HV feeder arrangements.
Appendix A. Short Term Plan (<5 years) - Constraints Options and Solutions

A.1 Arthurs Lake terminal substation

The transformers at Arthurs Lake terminal substation were installed in 1964 which implies a nominal end of life in 2014. Transend have indicated that the three single phase transformers will be replaced with a single 12 MVA 110/6.6 kV unit in 2013.

A.2 Kempton / F48190

- The areas around Kempton and Melton Mowbray (F48190) have overloaded feeders and acknowledged high voltage power quality problems. In general this area is being seen as having significant potential for irrigation, eg Clyde Irrigation Project, and as a consequence high use of electric water pumping. This network voltage is 11 kV, which is particularly intolerant to large motor starting which gives rise to ongoing power quality issues.
A.3 Bridgewater F48195 (Northern 11kV network - Kempton)

A.3.1. Options considered

- Maintain 11 kV network
- Augment to 22 kV network
- Do nothing

A.3.2. Possible Solution

- The areas of Melton Mowbray and north of Kempton will be progressively augmented from 11 kV to 22 kV and transferred to Meadowbank supply. The first stage, new connection at 22 kV, near Bothwell, is nearly complete with further 11/22 kV augmentations to be constructed in 2009/10 at a budgeted cost of $300k. There will be further work, possibly in 2010/12, to complete the conversion. This work has a conceptual cost of $400 k. This will also have the benefit to reduce load on Bridgewater Substation and in particular feeder 48190.
Further discussions are being held with Transend as to the feasibility of a second transformer at Tungatinah. Investigations are being conducted into the acquisition of a mobile generator of sufficient size as an alternative option.

A.4 Gretna and Westerway Zone substations

Both Gretna and Westerway zone substations are in poor condition and approaching the end of its useful life. It is proposed to decommission both the substations and augment the existing 11kV distribution network to 22kV to be supplied from Meadowbank terminal substation. This work is expected to be completed in 2013/14.

The nearby Hamilton 22/11 kV rural zone substation was decommissioned in 2009.

**A.4.1. Options considered**

- Replace Zone substations on a like for like basis.
- Augment 11kv to 22 kV to negate need of substations.
- Do nothing

**A.4.2. Possible Solution**

Gretna and Westerway analyses have shown that it is not warranted to replace these stations like for like. Further action has to be undertaken to address the likely failure of the zone transformers equipment. Further the embedded nature of 11 kV in a predominately 22 kV system does not allow for easy transfer of load for maintenance and emergency needs.
• **Reference to existing studies / approved studies**

- The respective 11 kV distribution networks are to be augmented to 22 kV thus allowing these minor stations to be decommissioned.
  - Gretna is in the first stage of a number of major stages. Stage 1 work is being conducted in 2009/10 at a budgeted cost of $100k
  - Diagram
  - Gretna remaining stages are to commence in 2012/13 and to be completed by 2013/14 at a budget cost of $1.6M.
  - Diagram
  - Westerway is to be 60% completed in 2009/10 at a cost of $2.8M. Further work to finalise 11 kV to 22 kV augmentations is planned in 2011/12 at a nominal cost of $400k

![Diagram of project areas](image-url)
• Wayatinah substation is to be replaced in 2009/10 at a budget cost of $2.9M.

• New Norfolk substation is to be replaced by 2010/11 at a budget cost $3.5M. Of note this will be using ex Sandy Bay and East Hobart power transformers to defer costs.
A.5  Lake Crescent SWER system / F45002

- Blah blah blah

Appendix B. Medium Term Plan (5 to 10 years) - Constraints Options and Solutions

B.1  Derwent Bridge Security

B.1.1. Options considered

- Do Nothing

- Install remedial works to allow connection of mobile generator

B.1.2. Possible Solution

At Derwent Bridge minor expenditure to provide a ‘plug in’ generator connection is considered the appropriate solution. Do nothing does not address the issue and the remedial action is relatively inexpensive.

It is intended to install prove a ‘plug in’ generator solution and minor augmentation (2 wire to 3 wire) of the existing 22kV network to manage the unsymmetrical load.
B.2 Tungatinah Security

B.2.1 Options
- Have Transend install a 2nd transformer.
- Maintain existing transformers
- Do nothing.
- Provide 22 kV link between Tungatinah substation and Wayatinah substation

B.2.2 Solutions
- Keep old transformers, as load is low and manage these into their twilight years.
- Link high level design at $3M is prohibitive.
- Reference to existing studies / approved studies

B.3 Lake Crescent SWER system

B.3.1 Options
- Embedded generator
- Replace SWER from Bothwell
- Install 3 phase link from Ross

B.3.2 Solutions

Appendix C. Long Term Plan (>10 years) - Constraints

Options and Solutions

C.1 Derwent Bridge terminal substation

Derwent Bridge terminal station has a single 10 MVA 110/22kV transformer installed in 2008. It supplies a single 22 kV distribution feeder with no ties to any adjacent substation.

With a peak load at Derwent Bridge of approximately 0.2 MVA, the lack of firm capacity is not considered a serious limitation, and certainly not justification for a second transformer or costly feeder works. No major developments are expected for the Derwent Bridge network in the foreseeable future.

C.2 Gordon terminal substation

Gordon terminal station has a single 10 MVA 110/22kV transformer installed in 1978. It supplies a single 22 kV distribution feeder with no ties to any adjacent substation.
With a peak load at Gordon of approximately 2.0 MVA, the lack of firm capacity is not considered a serious limitation, and certainly not justification for a second transformer or costly feeder works. No major developments are expected for the Gordon network in the foreseeable future.

C.3 Meadowbank terminal substation

Meadowbank terminal substation is equipped with a single 10 MVA 110/22kV transformer. Due to load growth on Meadowbank and the neighbouring New Norfolk terminal substation, it is expected that a second transformer will be required at Meadowbank in 2023. In conjunction with this work increased 22kV load transfer capacity from New Norfolk will be required to allow it to be off loaded.

Further detail and discussion on this project is included in The Central Area Strategic Plan provides the background to much of the planning information in this document. It can be found at: NW-#30141787-Central strategic plan Rev_5_2010 final report.

C.4 New Norfolk Zone substation

The existing 2 x 15 MVA 22/11kV transformers at New Norfolk zone substation were installed around 1970. Transend’s New Norfolk terminal substation is expected to exceed firm capacity in 2029.

A number of options have been identified which may address the loading issue on the Transend station and the likely age and condition issues at the New Norfolk zone substation by 2029. Options identified are:

- Convert the New Norfolk 11kV network to 22 kV and decommission New Norfolk zone substation
- Establish a New Norfolk 110/11kV substation

These options are discussed in detail in NW-#30141787-Central strategic plan Rev_5_2010 final report.

C.5 New Norfolk terminal substation

The existing New Norfolk 110/22 kV transformers were installed in 1987 and so are nominally end of life by 2037. Therefore it is expected that these transformers will be replaced in 2037. The nameplate rating to be installed will depend on whether or not the 11kV New Norfolk network has been retained.

C.6 Tods Corner zone substation

The existing 2 x 22/6.6 kV transformers at Tods Corner substation have been deemed to be end-of-life by 2020. Therefore it is proposed that the transformers be replaced with a new 22/6.6 kV unit in 2020 and the existing 6.6 kV line between Tod’s Corner and Arthur’s Lake is retained.
This project and other options considered to address this issue are discussed in detail in NW-#30141787-Central strategic plan Rev_5_2010 final report.

C.7 Tungatinah terminal substation

Transend are proposing to replace the two 5MVA 110/22kV transformers at Tungatinah with a single transformer once justified by condition assessment. There is currently no indication from Transend when this will be required, however this will cause security of supply issues to the Aurora 22 kV network supplied from Tungatinah. The option to connect to the Wayatinah 22 kV network by installing 11km overhead feeder at a cost of $3M has been ruled out as being too expensive. Discussions with Transend are ongoing regarding installation of a second transformer at Tungatinah.

Peak load on Tungatinah is less than 2 MVA, so capacity issues are not expected for the foreseeable future.

C.8 Waddamana terminal substation

Waddamana terminal substation is equipped with a single 5 MVA 110/22 kV transformer, providing no firm capacity. The transformer was installed in 1997. Waddamana has a peak load of approximately 1.2 MVA, which is adequately backed up by the Arthur’s Lake and Tod’s Corner substations. No capacity issues are expected at Waddamana for the foreseeable future.

C.9 Wayatinah zone substation

Wayatinah is expected to remain a single transformer 110/22 kV substation up to 2050. The backup supply from Meadowbank will provide sufficient backup for the foreseeable future.

Due to the low load growth in the area, and the backup supply provided by Meadowbank, the Wayatinah feeder network is not expected to require augmentation for the foreseeable future.

Appendix D. Technical Data

D.1 Substation loading

<table>
<thead>
<tr>
<th>Elements</th>
<th>No</th>
<th>Emergency Rating MVA</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>N-1 Load at Risk</th>
<th>Maximum Demand predicted summer 2009</th>
<th>Maximum Demand predicted for winter 2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformers</td>
<td>2</td>
<td>10</td>
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<td>45</td>
<td>22.5</td>
<td>22.5</td>
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<td>Distributed Subtransmission Feeder NNxxx</td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Gretna
### New Norfolk

<table>
<thead>
<tr>
<th>Elements</th>
<th>No</th>
<th>Emergency Rating MVA</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>Capacity with one element out of service (N-1)</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>Capacity with all elements in service (N)</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>Maximum Demand predicted summer 2009</th>
<th>N-1 Load at Risk</th>
<th>Winter MVA</th>
<th>Maximum Demand predicted for winter 2009</th>
<th>N-1 Load at Risk</th>
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<tr>
<td>Transformers</td>
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<td>0</td>
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**Subtransmission Feeder 39563**

**Distributed Subtransmission Feeder 39565**

### Wayatinah

<table>
<thead>
<tr>
<th>Elements</th>
<th>No</th>
<th>Emergency Rating MVA</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>Capacity with one element out of service (N-1)</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>Capacity with all elements in service (N)</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>Maximum Demand predicted summer 2009</th>
<th>N-1 Load at Risk</th>
<th>Winter MVA</th>
<th>Maximum Demand predicted for winter 2009</th>
<th>N-1 Load at Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformers</td>
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**Subtransmission Feeder 1**

**Subtransmission Feeder 2**

### Westerway

<table>
<thead>
<tr>
<th>Elements</th>
<th>No</th>
<th>Emergency Rating MVA</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>Capacity with one element out of service (N-1)</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>Capacity with all elements in service (N)</th>
<th>Summer MVA</th>
<th>Winter MVA</th>
<th>Maximum Demand predicted summer 2009</th>
<th>N-1 Load at Risk</th>
<th>Winter MVA</th>
<th>Maximum Demand predicted for winter 2009</th>
<th>N-1 Load at Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transformers</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td>45</td>
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<td>14.6</td>
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**Distributed Subtransmission Feeder NNxxx**

### Reference master document # 30006462
D.2 Aurora Zone Substation data sheet

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<th>Planning Area</th>
<th>Zone Substation</th>
<th>Type</th>
<th>Primary Voltage (kV)</th>
<th>Secondary Voltage</th>
<th>No of Feeders In Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central</td>
<td>Gretna</td>
<td>Rural - minor</td>
<td>22</td>
<td>11</td>
<td>2</td>
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<tr>
<td>Central</td>
<td>Hamilton</td>
<td>Rural - minor</td>
<td>22</td>
<td>11</td>
<td>0</td>
</tr>
<tr>
<td>Central</td>
<td>New Norfolk</td>
<td>Rural - minor</td>
<td>22</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>Central</td>
<td>Todds Corner</td>
<td>Rural - minor</td>
<td>6.6</td>
<td>22</td>
<td>1</td>
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<tr>
<td>Central</td>
<td>Wayatinah</td>
<td>Rural - minor</td>
<td>11</td>
<td>22</td>
<td>3</td>
</tr>
<tr>
<td>Central</td>
<td>Westerway</td>
<td>Rural - minor</td>
<td>22</td>
<td>11</td>
<td>2</td>
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</table>

Reference master document #30040697

D.3 Transend Station data sheet

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<th>Planning Area</th>
<th>Connect Point Substation</th>
<th>Connection Company</th>
<th>Connection Voltage kV</th>
<th>No. Of Connection Points</th>
<th>Type</th>
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<tbody>
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<td>Derwent Bridge Transend Networks</td>
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<tr>
<td>Central</td>
<td>Gordon Hydro Tasmania</td>
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<td>Meadowbank Transend Networks</td>
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</table>

Reference master document #30040697

D.4 High Voltage feeder loading

2008
### D.5 Transfer Capacity

- MD transfer capacity with other stations (order of)

<table>
<thead>
<tr>
<th>Planning Area</th>
<th>Station Description</th>
<th>Feeder Number</th>
<th>Voltage</th>
<th>Sum of MD (MVA)</th>
<th>Planning Std (MVA)</th>
<th>Load in 5 years (MVA)</th>
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</tbody>
</table>
Brief outline of transmission and subtransmission feeder arrangements, ratings and capabilities

Note it would be useful to include any details of reference documents and schematic diagrams

- HV feeder ratings, current summer and winter loads. MD’s
- Provide high and low load forecasts ie +/- 10% of base load as above for each HV feeder for the next 10 years
- Indicate anticipated summer and winter load growths for each of the existing HV feeders in the area including ratings of the feeder.
- As above for major zones
- Reference Transend Annual Planning Report.
Appendix E. Planning Criteria and Guidelines

E.1 Transmission Planning Criteria

Transend’s planning criteria are fundamentally based on:

- the National Electricity Rules (NER);
- the Electricity Supply Industry (Network Performance Requirements) Regulations 2007; and
- good electricity industry practice.

The following criteria are used when planning for the transmission system.

Transmission and transformer loading

- Transmission lines and autotransformer loadings for an intact system or for a contingency (N–1) should not exceed their continuous ratings in planning studies. For supply transformers four-hour emergency ratings can be used to defer augmentations depending on the peak duration of the load duration curve.
- Transmission line loading on circuits covered by NCSPS should not exceed 95 per cent of their rating for an intact system when Basslink is exporting. When Basslink is not in service or importing, standard N–1 criteria applies.

Load interruptions

For an intact system, ie. where no elements are out of service for maintenance the following should apply as per Network Performance Requirements:

- no credible single contingency event will interrupt more than 25 MW load;
- no single asset failure will interrupt more than 850 MW or, in any event cause a system black;
- the unserved energy to loads interrupted as a result of damage to a network element related to a credible contingency event must not exceed 300 MWh; and
- the unserved energy to loads interrupted as a result of a single asset failure must not exceed 3,000 MWh.
Single asset failure that would cause large load interruptions are the loss of a double circuit line, a bus section fault or a bus coupler fault. In calculating unserved energy, the ability to transfer load and the time required for load restoration should be taken into account.

*Exposure due to maintenance outage*

- Where a network element has been withdrawn from service for maintenance, replacement or repair, the energy exposed to interruption by a credible contingency event must not exceed 18,000 MWh.

In calculating unserved energy, the ability to transfer load should be taken into account.

*Maximum repair / replacement time*

Minimum Performance Requirements state that for the purpose of calculating unserved energy, any replacements or repairs undertaken, should not exceed the following:

- Transmission line repair – 48 hours
- Transformer replacement – 8 days
- Auto transformer replacement – 18 days

E.2 Distribution Planning Criteria

Key planning standards include:

**System Performance**

- Voltage regulation range of +6% and –6% of the nominal HV voltage and a LV voltage range of 230/400 V +10% and –2%;
- Power quality standards are recognised in accordance with the TEC, NER and applicable Australian Standards; and
- Tasmanian Reliability Performance Standards

Table Appendix E-1 Tasmanian Reliability Performance Standards
### Frequency and Duration Standards for Power Interruptions

<table>
<thead>
<tr>
<th>Community category</th>
<th>Frequency standard (Maximum average number of supply interruptions per year)</th>
<th>Duration standard (Maximum total time without electricity in a year measured in minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>For the category</td>
<td>For each community</td>
</tr>
<tr>
<td>Critical infrastructure</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>High density commercial</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Urban and regional centres</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Higher density rural</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>Lower density rural</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

*Source: Tasmanian Electricity Code*

#### Capacity

Maximum average loading considerations for distribution feeders facilitating HV feeder interconnectivity:

- 22 kV – 10 MVA continuous and 15 MVA (typically one hour) emergency;
- 11 kV - 5 MVA continuous and 7.5 MVA (typically one hour) emergency.

#### Security of Supply

Group firm philosophy or a deterministic planning standard, e.g. “N-1”, dependent on elements of security, load and exposure to risk

Schedule 5.1.2.2 (a) of the NER states:

> “In the satisfactory operating state, the power system must be capable of providing the highest reasonably expected requirement for power transfer (with appropriate recognition of diversity between individual peak requirements and the necessity to withstand credible contingency events) at any time.”