



ATTACHMENT 5.05

Investigation reports for reliability projects

Prepared by Endeavour Energy

January 2015



Reliability Investigation

Licence Conditions – September 2012

Feeder 7962 – Braeside Road, Greystanes

Strategic Asset Management

October 2012

Craig Willebrand
Reliability Analyst/Planner
Strategic Asset Management

Glenn Lee
Graduate Electrical Engineer
Strategic Asset Management

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1.0 INTRODUCTION

This feeder has not complied with the Individual Feeder Standards in the ‘Design, Reliability and Performance Licence Conditions’ over the last 12 months. Feeder 7962 recorded a SAIDI of 578 minutes which exceeds the SAIDI threshold of 350 minutes and a SAIFI of 4.1 which exceeds the licence conditions threshold of 4 for an ‘Urban’ feeder as stipulated in the licence conditions.

In accordance with the licence conditions a reliability investigation must be conducted immediately to determine the causes of the non-compliance. This investigation, including any recommended remedial works must be completed prior to the start of the following quarterly reporting period (3 months).

The recommendations of this report will be completed either through the inclusion of projects in the Reliability Works Program for capital works or issued to the relevant section of Endeavour Energy for immediate action such as thermo-vision inspections and vegetation clearing as operational works.

2.0 FEEDER CHARACTERISTICS

Characteristic	Value		
Feeder Category	Urban		
Customer Supplied by Feeder	851		
Maximum Demand of Feeder	143 A @ 11 kV		
Feeder Length (km)	Underground	Overhead	Total
	0.3	5.1	5.4
Local Government Area	Holroyd		

2.1 Feeder Layout



2.2 Feeder Description

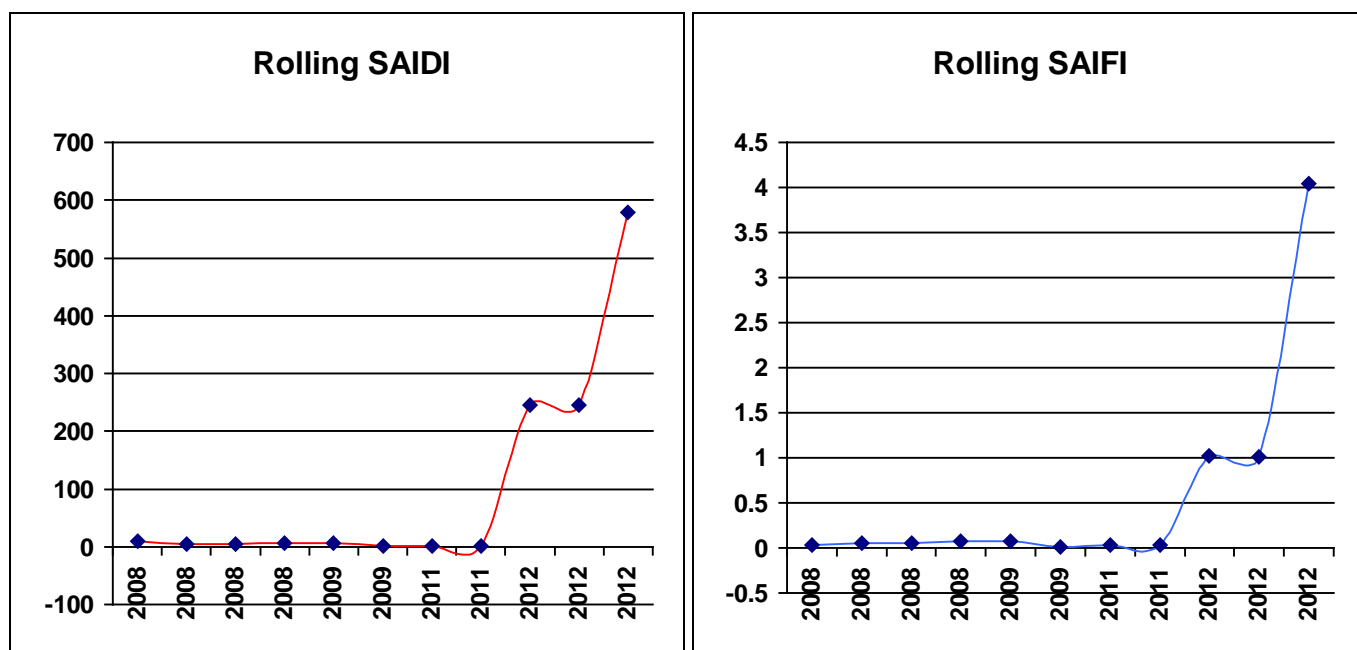
11 kV feeder 7962 is supplied from Greystanes ZS. This feeder is mainly overhead which provides power to residential customers in the Greystanes area.

3.0 RELIABILITY HISTORY

Reliability Performance by Quarter (Table)

Reliability sort by qtr								
Year	Qtr	SAIDI	SAIFI	Org SAIDI	Feeder	Fdr Cat	CMI	Fdr Cust
2009	1	6.43	0.07	0	7962	Urban	5257	
2009	3	1.33	0.01	0	7962	Urban	1092	13
2011	3	1.38	0.03	0	7962	Urban	1178	851
2011	4	1.38	0.03	0	7962	Urban	1178	851
2012	1	245.8	1.02	0.23	7962	Urban	208932	850
2012	2	245.51	1.01	0.23	7962	Urban	208932	851
2012	3	578.83	4.04	0.56	7962	Urban	492588	851

Reliability Performance by Quarter (Graph)



3.1 Reliability History Description

Prior to the September 2012 quarter, this feeder had very good reliability performance. This is the first quarter in which the feeder has been non-compliant or indicated as a >0.3 minute organisational SAIDI feeder. Feeder 7962's non-compliance is a result of several equipment failures throughout 2012.

4.0 SUMMARY OF OUTAGES

4.1 Last 12 Months

As can be seen in the following table, there are two incidents that have made this feeder non-compliant. The outage on the 19th February contributed 249 minutes to feeder SAIDI, and the outage on the 16th September (loss of Greystanes ZS) contributed 216 minutes to feeder SAIDI.

Feeder Outages (12 months)

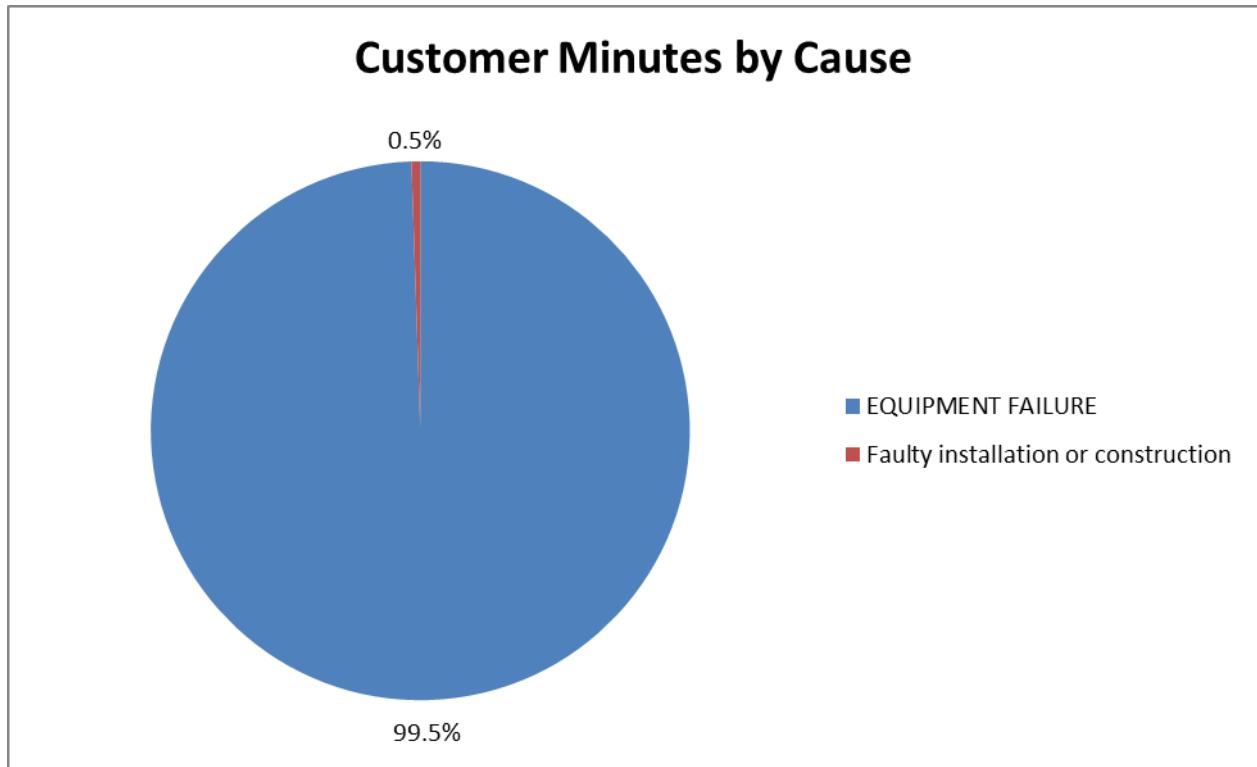
Date	Network	Comment	Customers	CMI	Contribution
19/02/2012	HVFEED	1498353 - HV MAINS DOWN HV/LV INTERMIX AND DEFECTIVE HV BOND ALDER PDE GREYSTANES TOWARDS USL 6417 - REFER ALSO 201201424	836	207754	42%
13/09/2012	Distribution	11kV B-phase Main down at USL 4511 Merrylands Rd Greystanes - Defective 11kV B-phase Pedestal at ABS 5153 Merrylands Rd Greystanes - Defective 11kV B-Phase Bond at USL 8291 Merrylands Rd Greystanes	852	95097	19%
16/09/2012	Distribution	Fdr 430 twisted with pilot and earth O/S #3 Great Western Highway Prospect - Loss of Geystanes ZSub. See Log 201205906 and 201205907	858	185255	38%
21/09/2012	Transmission Voltage	Temporary protection installed incorrectly on fdr 426 - Loss of Greystanes Zone Sub 9513	857	2571	1%

5.0 CAUSE ANALYSIS

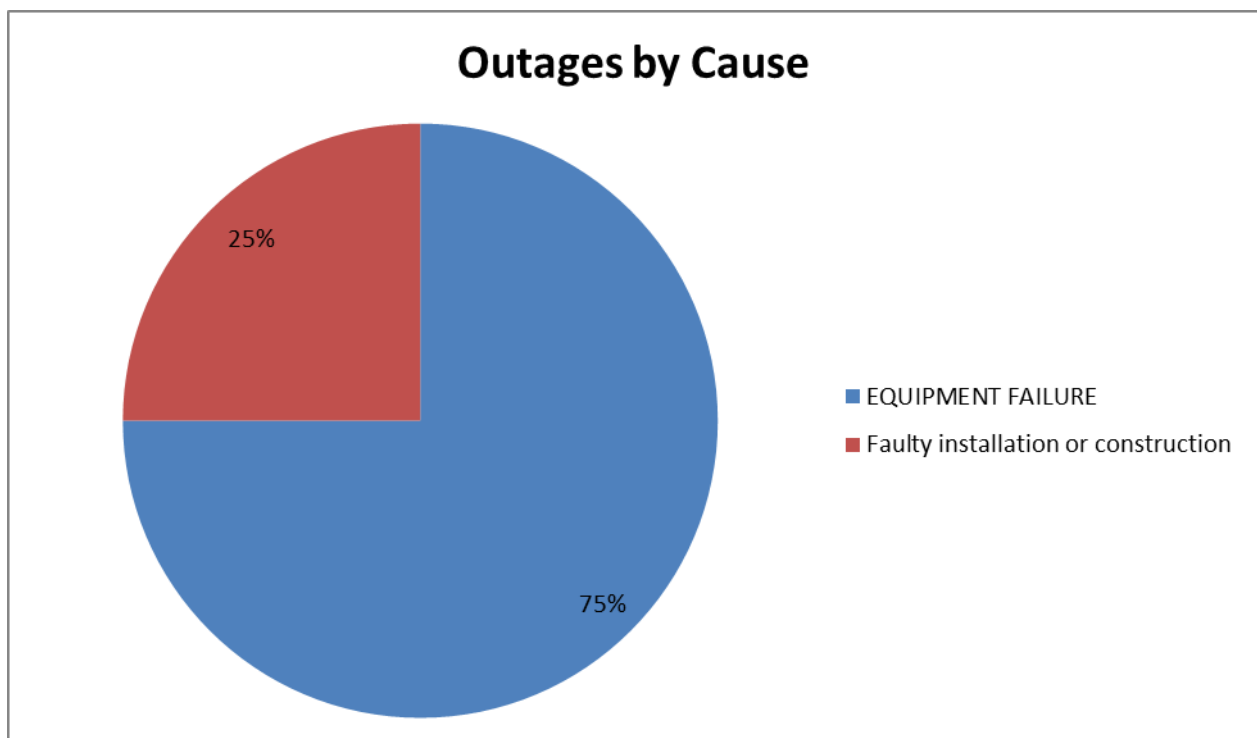
5.1 Last 12 months

99.5% of outages on this feeder in the past 12 months have been due to equipment failure. Two particular events have contributed 80% of the total feeder SAIDI in this period.

5.1.1 SAIDI Contribution by cause type



5.1.2 Total Outages by cause type



6.0 EXISTING PLANNED WORKS

There are no existing planned works for this feeder.

7.0 RECOMMENDATIONS

7.1 Operational Works

- *Thermo-vision*

It is proposed to conduct a thermo-vision analysis on this feeder to identify any potential hot-joints or future problem areas for equipment failure.

7.2 Capital Works

- *Auto-Recloser*

It is proposed to install an Auto-Recloser on pole 1344 on Lance Cres. This will sectionalise the feeder and minimise the effects of downstream faults from the Auto-Recloser location.

Cost - \$51,500

- *Load Break Switches*

There are two proposed sites to install Load Break Switches on this feeder.

The first location is on Braeside Rd replacing USLs 5139. This will allow sectionalisation of the feeder and remote switching, minimising outage durations.

The second location is at the open ABS 5790 on Old Prospect Rd. This will allow remote switching between this and adjacent feeder HR1213.

Cost - \$38,000 ea

- *Drop Out Fuses*

There are two proposed sites to install DOFs located on spurs off this feeder.

The first location is on pole 1222 on Lloyd St.

The second location is on Walnut St; however, a project has already been created in the 2013/14 DWP under HV Development works.

Cost - \$17,500

8.0 ATTACHMENTS

8.1 Reliability Modelling

Baseline Model

RAPID 1.0.3.0 - Feeder Reliability analysis from file: RDB_Files/9513_RDB.per
 Created by leegle on L2KN762S. Thu 20-Dec-12 10:47 AM

Default Values:	
Fault Rate	0.100 /km pa
Switching Time	2.0 hrs
Repair Time	4.0 hrs
Based on Customer	

	Outputs			Improvement (%)
	Baseline	Calculated		
SAIDI	525	525	mins	0%
SAIFI	3.98	3.98	Outages/pa	0%
CAIDI	132	132	mins	(0%)
Est Fault Rate	0.834			

Level	Device Name	Connected Customers	% of Feeder Customers	Trunk Customers	Trunk Customers %	Trunk Customer km	Adjustable Data					Conductor Length (km)	Trunk Length (km)
							Fault Rate	Switching Time (hrs)	Repair Time (hrs)	Trunk Load Switchable (%)	Downstream Load Switchable (%)		
1	Fdr 7962 - ZS9513	867	100%	-	-	4,137	0.833	2.0	4.0	90%	90%	4.8	

Modified Model

RAPID 1.0.3.0 - Feeder Reliability analysis from file: RDB_Files/9513_Compare.per
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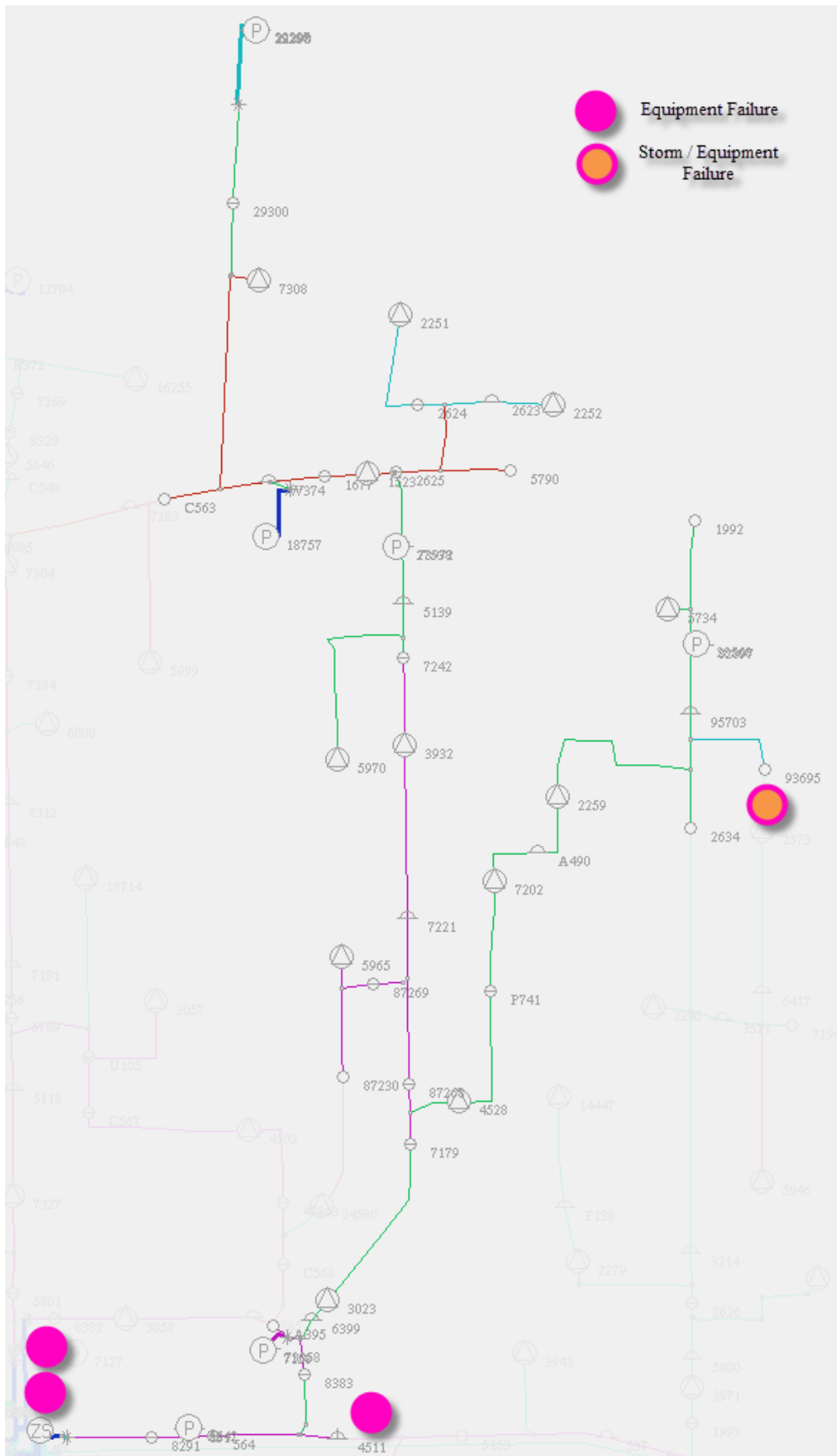
Default Values:	
Fault Rate	0.100 /km pa
Switching Time	2.0 hrs
Repair Time	4.0 hrs
Based on Customer	

	Outputs			Improvement (%)
	Baseline	Calculated		
SAIDI	525	431	mins	18%
SAIFI	3.98	3.28	Outages/pa	18%
CAIDI	132	131	mins	1%
Est Fault Rate	1.504			

Level	Device Name	Connected Customers	% of Feeder Customers	Trunk Customers	Trunk Customers %	Trunk Customer km	Adjustable Data					Conductor Length (km)	Trunk Length (km)
							Fault Rate	Switching Time (hrs)	Repair Time (hrs)	Trunk Load Switchable (%)	Downstream Load Switchable (%)		
1	Fdr 7962 - ZS9513	867	100%	235	27%	1,418	1.834			90%	90%	4.8	1.6
2	Recloser: AR1	210	24%	-	-	227	0.926			90%	90%	1.1	
2	Recloser: LBS	422	49%	249	59%	587	0.050	0.2		90%	90%	2.1	1.4
3	DOF: DOF2	54	6%	-	-	14	0.100			50%	-	0.3	
3	DOF: DOF1	119	14%	-	-	49	0.100			50%	-	0.4	

If implemented, the recommendations of this report are expected to provide up to an 18% improvement in reliability performance.

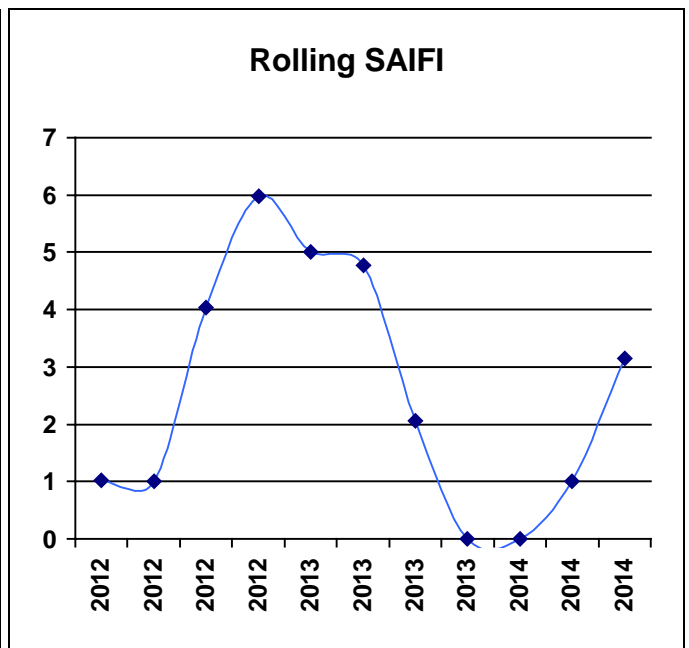
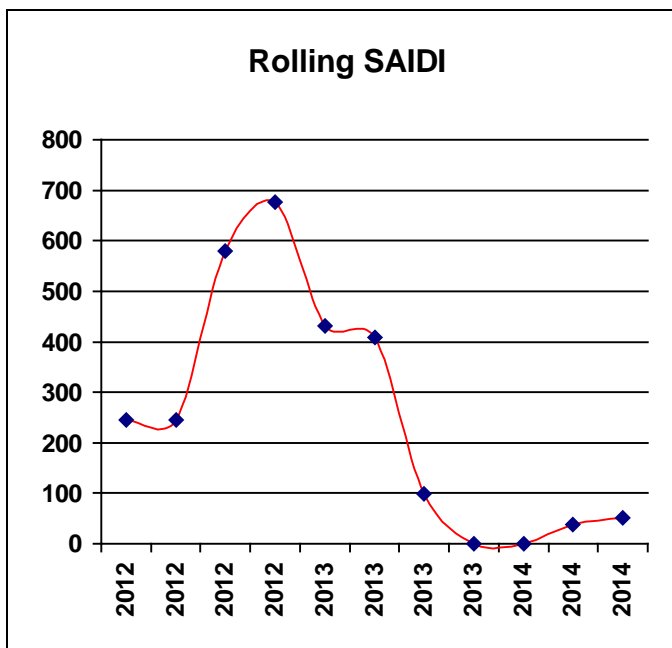
9.0 Feeder Dot Map (3 Years)



10.0 Performance Review (December 2014)

Recent performance of this feeder has shown significant reliability improvement (particularly in SAIDI). This is demonstrated by the following table and graphs:

Reliability sort by qtr								
Year	Qtr	SAIDI	SAIFI	Org SAIDI	Feeder	Fdr Cat	CMI	Fdr Cust
2012	4	676.06	5.98	0.65	7962	Urban	575333	851
2013	1	431.93	5	0.41	7962	Urban	367579	851
2013	2	408.33	4.77	0.39	7962	Urban	388732	952
2013	3	99.12	2.06	0.09	7962	Urban	83658.493169	844
2013	4	0.91	0	0	7962	Urban	775	849
2014	1	0.91	0	0	7962	Urban	775	851
2014	2	38.33	1	0.03	7962	Urban	32816.9412028056	856
2014	3	50.83	3.15	0.04	7962	Urban	43614.9412028056	858



As expected, further sectionalisation of the feeder has improved the reliability significantly. This can be attributed to the minimisation of customers affected by faults in addition to the ability to fault find and restore unaffected customers more quickly. It is expected that this feeder will remain compliant into the future.



Reliability Investigation

Licence Conditions – June 2013

Feeder D814 – MacDonald, Wisemans

Asset and Network Planning

August 2013

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1.0 INTRODUCTION

This feeder has not complied with the 'Individual Feeder Standards' within the 'Design, Reliability and Performance Licence Conditions' over the last 12 months. Feeder D814 recorded a SAIDI of 1042 minutes, which exceeds the SAIDI threshold of 1000 minutes for a 'Short Rural' feeder as stipulated in the NSW Reliability Licence Conditions.

In accordance with the licence conditions, a reliability investigation must be conducted immediately to determine the causes of the non-compliance. This investigation (including any recommended remedial works) must be completed prior to the start of the following quarterly reporting period (3 months).

The recommendations of this report will be completed either through the inclusion of projects in the Reliability Works Program for capital works, or issued to the relevant section of Endeavour Energy for immediate action such as Thermo-Vision inspections and vegetation clearing as operational works.

2.0 RELIABILITY HISTORY

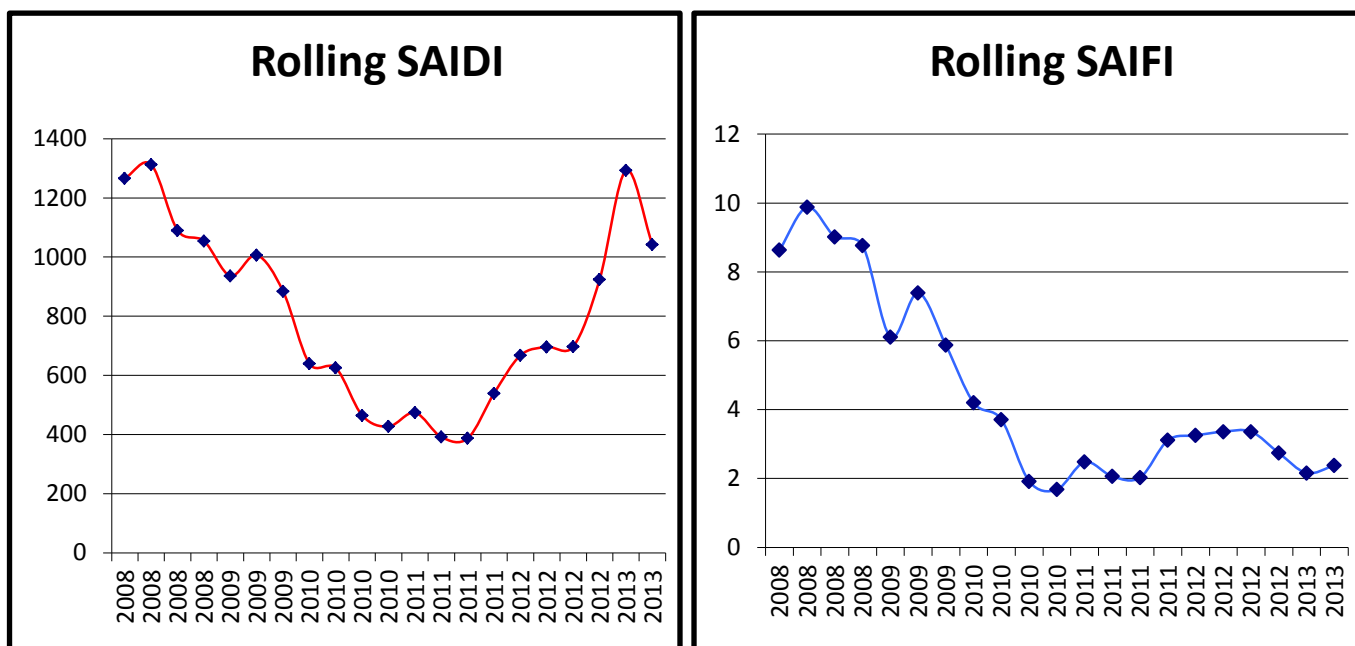
2.1 RELIABILITY HISTORY DESCRIPTION

This feeder has previously been identified as a non-compliant feeder and documented in past reports. Please refer to these previous reports (the most recent being March 2013) for more specific information regarding this feeder. The most up-to-date reliability performance statistics are shown below.

Reliability Performance by Quarter (Table)

Reliability sort by qtr								
Year	Qtr	SAIDI	SAIFI	Org SAIDI	Feeder	Fdr Cat	CMI	Fdr Cust
2010	3	464.41	1.92	0.16	D814	Rural Short	143041	593
2010	4	427.11	1.68	0.15	D814	Rural Short	131550	308
2011	1	473.89	2.48	0.16	D814	Rural Short	145960	308
2011	2	391.54	2.06	0.16	D814	Rural Short	144480	369
2011	3	387.2	2.03	0.16	D814	Rural Short	144039	372
2011	4	539.25	3.11	0.22	D814	Rural Short	200371	371.5714286
2012	1	667.59	3.25	0.27	D814	Rural Short	236327	354
2012	2	696.37	3.36	0.29	D814	Rural Short	256963	369
2012	3	697.15	3.36	0.29	D814	Rural Short	257252	369
2012	4	923.77	2.74	0.38	D814	Rural Short	340874	369
2013	1	1292.83	2.16	0.55	D814	Rural Short	489985	379
2013	2	1042.2	2.38	0.56	D814	Rural Short	564873	542

Reliability Performance by Quarter (Graph)



Two outages in the most recent quarter have ensured this feeder has remained non-compliant in terms of the NSW Reliability Licence Conditions. The majority of SAIDI can be attributed to two separate outages (in November 2012 and January 2013 respectively), contributing a combined 1104 minutes.

3.0 EXISTING PLANNED WORKS

As mentioned in the previous report, vegetation management was an operational focus for this feeder to ensure it became compliant with the NSW Reliability Licence Conditions. Discussions with Rod Tennison regarding 'clear to sky' trimming and providing extra attention to this feeder in terms of vegetation management have resulted in the decision to propose augments in certain sections of this feeder.

In summary, discussions with Rod were about the inability of excessive trimming to have a significant effect on the reliability of this feeder. This is due to the nature of the vegetation (it is located predominantly on hillside surfaces, meaning they are susceptible to blow onto the line unless several rows of trees are fully cut back, providing a negative visual and environmental impact). The only foreseeable solution is to augment problem spans to NMSHVABC, which is strong enough to withstand some vegetation impact (though not fully protected).

4.0 RECOMMENDATIONS

4.1 OPERATIONAL WORKS

There are no operational works proposed for this feeder.

4.2 CAPITAL WORKS

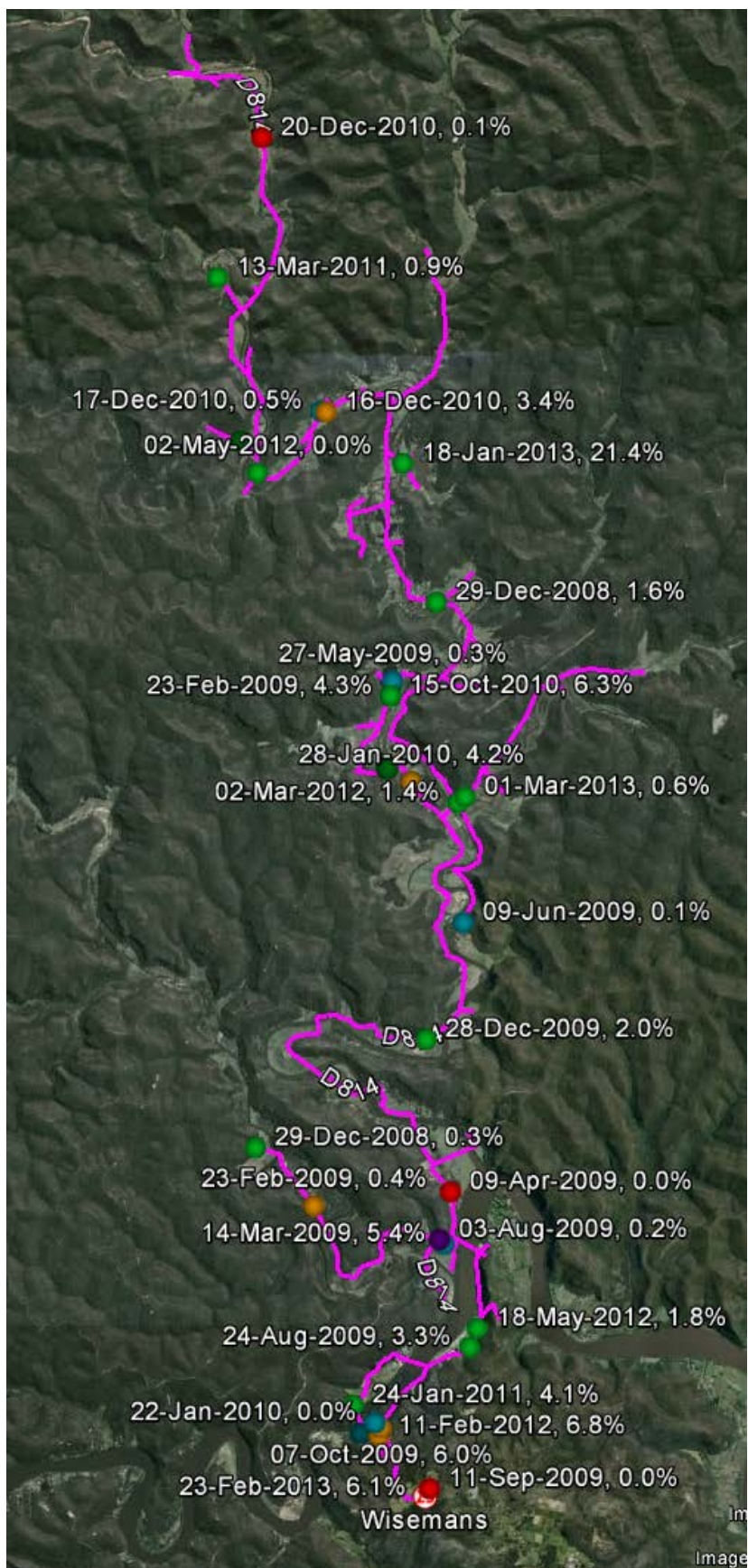
Project	Description	Cost
Augment	It is proposed to augment the existing bare conductor to 150mm ² HVABC along River Rd from poles 30 to 35. This augment will strengthen the backbone's resilience to vegetation related faults. The augment includes the replacement of USL 5398 with an ABS.	\$136,000
Augment	It is proposed to augment the existing bare conductor to 150mm ² HVABC along River Rd from poles 115 to 767521. This augment will strengthen the backbone's resilience to vegetation related faults. The augment includes the replacement of USL R742 with a Type 1 LBS.	\$308,000
Augment	It is proposed to augment the existing bare conductor to 150mm ² HVABC along St Albans Rd from poles 789115 to 311058. This augment will strengthen the backbone's resilience to vegetation related faults. The augment also includes the replacement of ABS X101 with a Type 1 LBS.	\$340,000
Drop Out Fuses	It is proposed to install a set of DOFs on the spur towards subs 2032 and 2033. These DOFs will protect the backbone from fault occurring on this spur and also help with determining which side of the river the fault is on.	\$17,000
	TOTAL	\$801,000

5.0 CONCLUSION

To calculate the reliability improvement for the proposed projects, the outages on record affecting the areas now protected by augments or DOFs were subtracted from a 5 year average SAIDI and SAIFI calculation. This calculation showed a reliability improvement of 54.2% for SAIDI and 66.5% for SAIFI. These projects are expected to improve the reliability performance of the feeder to a point by which it complies with the Licence Conditions upon implementation.

6.0 ATTACHMENTS

Dot Map (5 Years)





Reliability Investigation

Licence Conditions – March 2013

Feeder 55890 – Kentwell Street, Jasper Rd

Strategic Asset Management

April 2013

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1.0 INTRODUCTION

This feeder has not complied with the 'Individual Feeder Standards' within the 'Design, Reliability and Performance Licence Conditions' over the last 12 months. Feeder 55890 recorded a SAIFI of 4.2, which exceeds the SAIFI threshold of 4 outages for an 'Urban' feeder as stipulated in the NSW Reliability Licence Conditions.

In accordance with the licence conditions, a reliability investigation must be conducted immediately to determine the causes of the non-compliance. This investigation (including any recommended remedial works) must be completed prior to the start of the following quarterly reporting period (3 months).

The recommendations of this report will be completed either through the inclusion of projects in the Reliability Works Program for capital works, or issued to the relevant section of Endeavour Energy for immediate action such as Thermo-Vision inspections and vegetation clearing as operational works.

2.0 FEEDER CHARACTERISTICS

Characteristic	Value		
Feeder Category	Urban		
Customers Supplied by Feeder	1500		
Maximum Demand of Feeder	244A @ 11kV		
Feeder Length (km)	Underground	Overhead	Total
	7.16	1.59	8.75
Local Government Area	PENCC		

2.1 FEEDER LAYOUT

2.2 FEEDER DESCRIPTION



Feeder 55890 supplies power to 1500 customers in the Baulkham Hills and Winston Hills areas. The feeder has 4 ties to other feeders; two to other Jasper Rd ZS feeders (55876 and 55867), one to Northmead ZS (3357) and one to North Rocks ZS (8744).

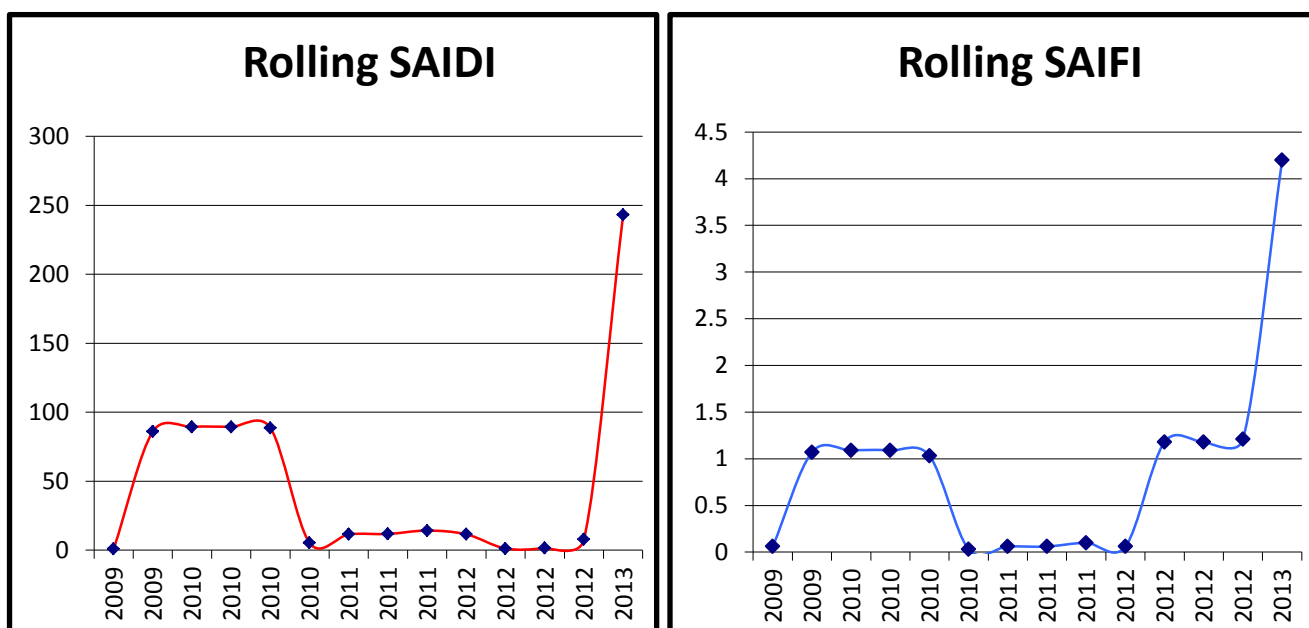
The network is residential with a mix of overhead and underground (with the majority underground). Due to this majority of underground cable the highest risk of outages is due to equipment failure.

3.0 RELIABILITY HISTORY

Reliability Performance by Quarter (Table)

Reliability sort by qtr								
Year	Qtr	SAIDI	SAIFI	Org SAIDI	Feeder	Fdr Cat	CMI	Fdr Cust
2010	2	89.37	1.09	0.13	55890	Urban	117347	1313
2010	3	88.56	1.03	0.13	55890	Urban	116284	1354
2010	4	5.26	0.03	0	55890	Urban	6916	1313
2011	2	11.46	0.06	0.01	55890	Urban	15704	1370
2011	3	11.75	0.06	0.01	55890	Urban	15704	1336
2011	4	14.2	0.1	0.02	55890	Urban	18980	1336
2012	1	11.46	0.06	0.01	55890	Urban	15704	1370
2012	2	1.18	1.18	0	55890	Urban	1622	1370
2012	3	1.6	1.18	0	55890	Urban	2199	1370
2012	4	7.73	1.21	0.01	55890	Urban	10599	1370
2013	1	243.01	4.2	0.41	55890	Urban	364521.932754881	1500

Reliability Performance by Quarter (Graph)



3.1 RELIABILITY HISTORY DESCRIPTION

In recent history, this feeder has been a strong performer in terms of reliability; however, 4 significant outages in the past 2 months have increased the SAIFI of the feeder to 4.2, which is above the NSW Reliability Licence Conditions.

4.0 SUMMARY OF OUTAGES

4.1 LAST 12 MONTHS

This feeder has breached the licence conditions for SAIFI mainly due to 4 outages occurring in February and March this year. Of these 4 outages, three were due to defective equipment and one due to tree contact. A previous outage in April 2012 has ensured the feeder breached licence conditions in the March 2013 quarter.

Feeder Outages (12 Months)

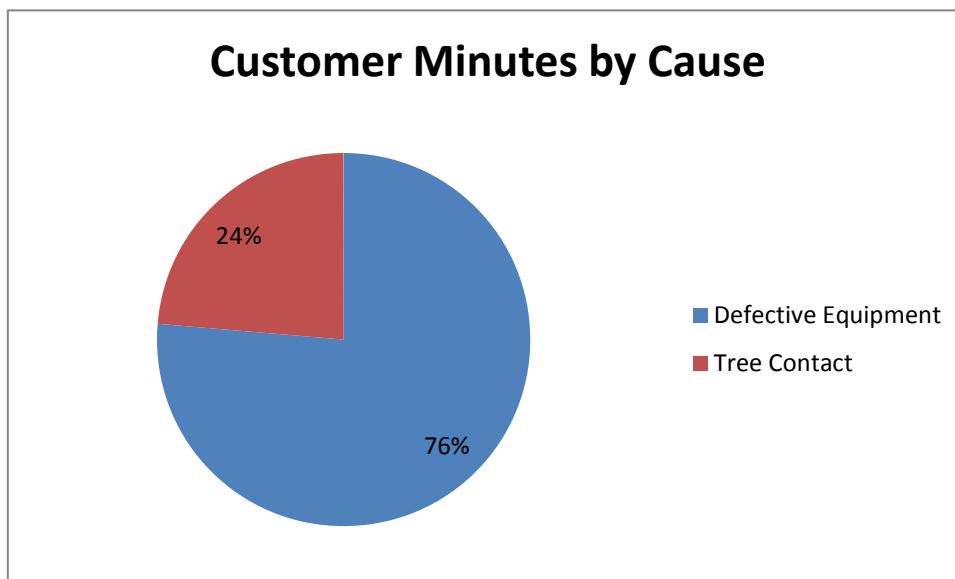
Creation Time	OMS Comments	Norm CustInt	NormCMI	Cause	Contirbution
23/04/2012	branch on hv mains 5 metres nth usl 431. some burn marks. Region to check in daylight. TREE BRANCH ON 11KV MAINS AT 5 METERS NORTH OF USL 431, COOK ST, JASPER RD.	1622	1622	Tree Contact	0%
4/02/2013	Defective 11kV B-phase Connection at Pole 2175 (PL 547257) Owen Ave, Baulkham Hills	1524	143164	Defective Equipment	34%
4/02/2013	UGOH Blown between Sw 24031 @ Sub 17795 & ABS 78788 - Canyon RD Baulkham Hills	138	36862	Defective Equipment	9%
10/03/2013	Defective Battery Charger at Jasper Road ZS - Zone Substation Isolated due to lack of Protection	1500	139500	Defective Equipment	33%
27/03/2013	Tree on Mains O/S #17 James St Baulkham Hills	2305	97424	Tree Contact	23%

5.0 CAUSE ANALYSIS

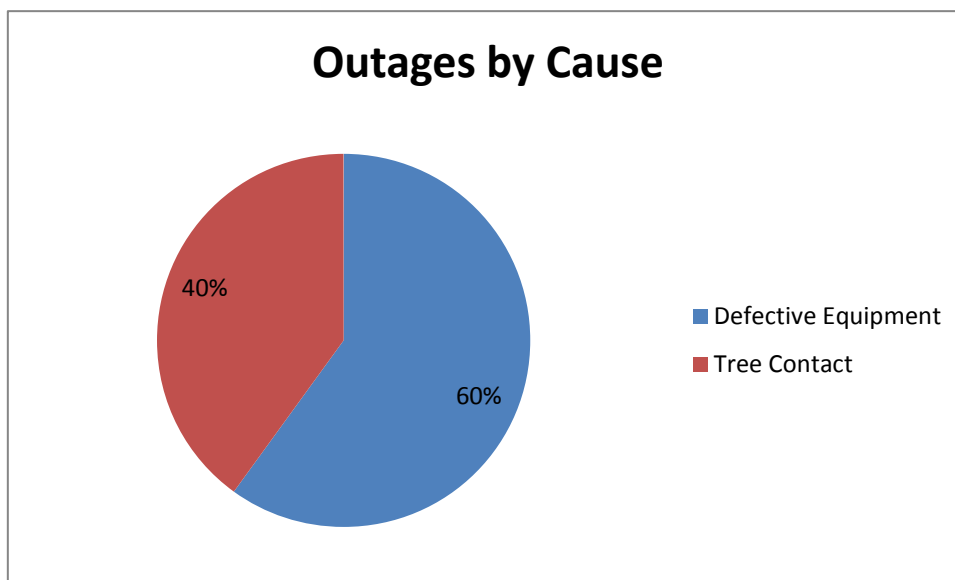
5.1 LAST 12 MONTHS

As can be seen in the following pie charts, outages in the past 12 months can be attributed to defective equipment and tree contact.

5.1.1 SAIDI CONTRIBUTION BY CAUSE TYPE



5.1.2 TOTAL OUTAGES BY CAUSE TYPE



6.0 EXISTING PLANNED WORKS

There are no existing planned works for this feeder.

7.0 RECOMMENDATIONS

7.1 OPERATIONAL WORKS

There are no operational works proposed for this feeder.

7.2 CAPITAL WORKS

Project	Description	Cost
Augment	It is proposed to augment 2 spans of bare conductor to 120mm ² CCT on the corner of James St and Ula Cres in Baulkham Hills. This section of network (between poles 765376 and 765375) is at high risk to vegetation related faults and this augment will significantly reduce the risk of falling branches causing an entire feeder outage.	\$44,000
Augment	It is proposed to augment 5 spans of bare conductor to 120mm ² CCT on Cook St in Baulkham Hills. The augment will include the replacement of 2 sets of USLs with an LBS and ABS respectively. This section of network (between poles 2604 and 1023) is at high risk to vegetation related faults and this augment will significantly reduce the risk of falling branches causing an entire feeder outage.	\$100,000
	TOTAL	\$144,000

8.0 RELIABILITY MODELLING

To determine the positive impact of the 2 proposed augments on this feeder, the SAIDI and SAIFI of this feeder over the past 5 years was assessed. To calculate the improvement, a baseline average was compared to an average that didn't include vegetation faults in the 2 specific sections of network. This method is considered a fair reflection of past SAIDI and SAIFI as the 2 outages on the areas in question were determined to be due to branches landing on mains (not bringing the conductors down). If the conductor wasn't bare (i.e. CCT or HVABC), both of these outages could have been avoided. 5 years is the chosen timeframe as this is believed to be a large enough sample space to truly reflect the reliability performance of the feeder.

The simple calculations are shown below:

SAIDI ave. over 5 yrs	53.1388	
SAIDI ave. over 5 yrs less 2 veg outages	39.93266667	
Ave. SAIDI saving per year	13.20613333	24.9%
SAIFI ave. over 5 yrs	0.998718861	
SAIFI ave. over 5 yrs less 2 veg outages	0.439715302	
Ave. SAIFI saving per year	0.559003559	56.0%

9.0 CONCLUSION

With vegetation being a major contributor to this feeder becoming non-compliant, 2 augments have been proposed in areas identified by past fault locations which have been identified as high risk to vegetation related faults as a result of the feeder patrol conducted for this report. Whilst equipment failure has also been a large contributor to outages on this feeder, it must be noted that the significant failures have been repaired upon restoration of the outages. The feeder patrol did not identify any ageing equipment or sections of network highly susceptible to equipment failure related faults.

As shown in the reliability modelling section of this report, the 2 proposed augments are predicted to provide a 24.9% and 56% improvement in SAIDI and SAIFI on this feeder respectively.

10.0 ATTACHMENTS

Dot Map (5 Years)

