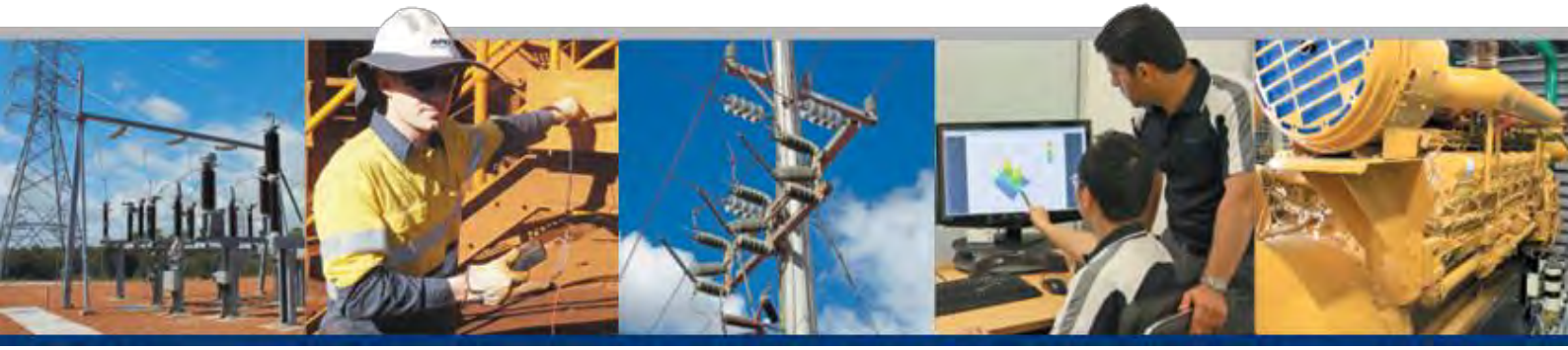

BHP BILLITON IRON ORE
NEWMAN TOWNSHIP ELECTRICITY SUPPLY

ANNUAL AUDIT REPORT ON COMPLIANCE MONITORING SYSTEMS 2015/2016 FINANCIAL YEAR

REVISION A

25/08/2016

APD Job Number: W_APD04607

APD POWER ENGINEERING

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EXECUTIVE SUMMARY

BHP Billiton Iron Ore (BHPBIO) is one of the world's major suppliers of iron ore and is based in the Pilbara region of Western Australia.

The township of Newman is located approximately 1200km to the north of Perth, within the Shire of East Pilbara. The electricity network is owned, governed and operated by BHP Billiton Iron Ore Supply Authority (BHPBIOSA). The network encompasses the township of Newman, Newman Airport, Capricorn Roadhouse, town water supply bore field, Mt Whaleback iron ore mine, and several smaller mine leases in the adjacent areas.

In accordance with Western Australia Electricity Industry Code 2005 (the Code), the electrical supply authority must publish a report setting out the information described in Schedule 1 of the Code, in respect to each year ending on 30th of June. This document, known as the Annual Audit Report, is to provide the full suite of information outlined in Schedule 1 of the Code, relating to the Network Quality and Reliability of Supply. As per the Code's Division 3 Section 26 Performance Reporting: BHPBIOSA, as the network owner and operator, is required to arrange an independent audit, and subsequent report, on the operation of the systems that the *distributor* has in place for monitoring its compliance to the Code's Part 2.

The audit interviews where undertaken on the 13th July 2016 at BHPBIOSA's Newman offices; majority of relevant stakeholders made themselves available for the audit process. It was noted by several interviewees that positive change within the business had occurred since the previous reporting period.

The results for 2015/2016 audit (together with the previous year's results) are shown below in the table titled 'Audit Scorecard'. General improvement has been noted in areas listed below:

- Inclusion of more accurate and detailed information on fault logs (network voltage, accurate record of time, probable cause of fault investigation and general switching performed to reconfigure the network);
- An increased focus toward maintaining and improving network reliability through regular monitoring and targeted asset replacement program, based upon the fault frequency and criticality as well as the failure mode;
- Separation of Maintenance and Operations teams to ensure effective implementation and control of operation and maintenance activities;
- Automation of inspection works and follow-up on compliance issues and/or defects (i.e., software development already commenced);
- Updated ISP (Inspection System Plan) and Manual documents (from 2005 to 2016 version), already submitted to Energy Safety for approval; and finally
- Continuous reduction in the number of outages over the course of last 4 FYs, from 42 incidents in 2013 to only 8 in 2015/16 FY.

There is an area where BHPBIOSA can improve:

- Permanent PQ monitoring of the LV network in order to ensure compliant supply at the customer's *point of connection*;
- Accurate and consistent documentation of planned and unplanned outages; and
- Roll-out of the automated inspection system and better record keeping for Energy Safety Audit reports (i.e., shock and other defect incidents).

With respects to the holistic electrical network, the recent PQ metering data indicates that Newman's electrical network has undergone noteworthy improvements to maintain its reputation as a robust and inherently good network. The basic electrical parameters of voltage, frequency and voltage total harmonic distortion were consistently stable and well within compliance-levels. There are a very limited number of instances (i.e., under 0.1% of the measurement period) where the maximum magnitude of certain electrical parameters were found to exceed the limits prescribed by the Code. However, this is not deemed as a major compliance issue due to the temporary and extremely isolated nature of the instances. It is recommended that BHPBIOSA investigate such events, the outcome of which could indicate deteriorating equipment or non-compliant loads acting as sources of excessive harmonics.

Audit Scorecard		
Audit Description	Audit Overall Rating	
	2014/2015	2015/2016
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards – Section 6 - **Voltage Fluctuations**		
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards – Section 7 - **Harmonic Distortion**		
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards – **Voltage Level**		
The Electricity Industry Code 2005 Part 2 Division 1 – Quality Standards – **Frequency**		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers – Section 9 – **General standard of reliability**		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers – Section 10 – **Duty to reduce effect of interruption**		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers – Section 11 – **Planned Interruptions**		
The Electricity Industry Code 2005 Part 2 Division 2 – Standards for the interruption of supply to individual customers – Section 12 – **Significant Interruptions to Small Customers**		
The Electricity Industry Code 2005 Part 2 Division 3 – Standards for the duration of interruption of supply in particular areas – Section 13 – **Standard for Other Areas (Newman Township electricity system 290mins)**		

Legend		
Overall Compliance Rating	Description	
	High	Best practice quality systems and processes
	Medium – High	Above average quality systems and processes
	Medium	Adequate quality systems and processes
	Low – Medium	Quality systems and processes require further development
	Low	Quality systems and processes require major further development

TABLE OF CONTENTS

1. INTRODUCTION 8

2. SCOPE OF AUDIT 9

3. AUDIT METHODOLOGY 10

3.1. Audit Flowchart 10
3.2. Audit Evaluation Matrix 10

4. AUDIT RESULTS 13

4.1. Part 2, Division 1 – Quality Standards - Section 6(2), 7 & 8 (a)(b) 13
4.2. Part 2, Division 2 – Standards for the Interruption of Supply to Individual Customers, Section 9 & Section 10 16
4.3. Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 11; Section 12; and Division 3 Section 13 18

5. CONCLUSION 20

6. RECOMMENDATIONS 21

6.1. Outage Event Recording System 21
6.2. Power Quality Monitoring System 21
6.3. New Customer Survey Feedback 22
6.4. Planned Outage Notifications 22
6.5. Total Number of Customers and Their Distribution Throughout the Network 23

APPENDIX A NEWMAN TOWNSHIP (SLD & MAP) 24

LIST OF TABLES

Table 1 | Audit of compliance management systems and processes evaluation matrix 11
Table 2 | Overall compliance rating table 12
Table 3 | Part 2 Division 1 Section 6(2), 7 & 8 (a) (b) - Evaluation Matrix 14
Table 4 | Part 2 Division 2 Section 9 & 10 - Evaluation Matrix 16
Table 5 | Part 2 Division 2 Section 11, 12 & Division 3 Section 13 - Evaluation Matrix 18

1. INTRODUCTION

BHP Billiton Iron Ore (BHPBIO) is one of the world's major suppliers of iron ore and is based in the Pilbara region of Western Australia.

The township of Newman is located approximately 1200km to the north of Perth, within the Shire of East Pilbara. It is the main town for the Mt Whaleback iron ore mine, Mining Area C and several smaller satellite mines.

The electricity network is owned, governed and operated by BHP Billiton Iron Ore Supply Authority (BHPBIOSA). The network encompasses the township of Newman, Newman Airport, Capricorn Roadhouse, town water supply bore field, Mt Whaleback iron ore mine, and several smaller mine leases in the adjacent areas.

At present, the township of Newman has approximately 2938 premises comprised of a mixture of residential and commercial customers.

In accordance with Western Australia Electricity Industry Code 2005 (the Code), the electrical supply authority must publish a report setting out the information described in Schedule 1 of the Code, in respect to each year ending on 30th of June. This document, known as the annual audit report, is to provide the full suite of information outlined in Schedule 1 of the Code, relating to the Network Quality and Reliability of Supply.

The Code is effectively written in four Parts plus a reporting-requirements schedule; namely:

1. Part 1: Preliminary information associated with term of reference.
2. Part 2: Quality and reliability standards, which is further partitioned into 4 *divisions*.
3. Part 3: Payment to customers for lack of regulatory adherence.
4. Part 4: Incidental duties as a Supply Authority.
5. Schedule 1: Information to be published in this report.

As per the Code's Division 3 Section 26 Performance Reporting: BHPBIOSA as distributor is required to arrange an independent audit, and subsequent report, on the operation of the systems that the distributor has in place for monitoring its compliance to the Code's Part 2.

APD were engaged by BHPBIOSA to undertake the required audit and report on the current compliance monitoring processes and systems that BHPBIOSA have in place to ensure compliance with the Code.

2. SCOPE OF AUDIT

The scope of audit was limited to the review of the policies, guidelines, processes, systems and procedures that BHPBIOSA currently have in place to ensure that the network is complying with the following performance requirements specified in the Code:

- Part 2, Division 1 – Quality Standards, Section 6(2) – Voltage Fluctuations
- Part 2, Division 1 – Quality Standards, Section 7 – Harmonics
- Part 2, Division 1 – Quality Standards, Section 8 – Duty to disconnect if damage may result, Note (a) Voltage Levels Compliance
- Part 2, Division 1 – Quality Standards, Section 8 – Duty to disconnect if damage may result, Note (b) Frequency Levels Compliance
- Part 2, Division 1 – Quality Standards, Section 8 – Duty to disconnect if damage may result
- Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 9 – General standard of reliability
- Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 10 – Duty to reduce effect of interruption
- Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 11 – Planned interruptions
- Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 12 – Significant interruptions to small use customers
- Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 13 - Standards prescribed for particular areas

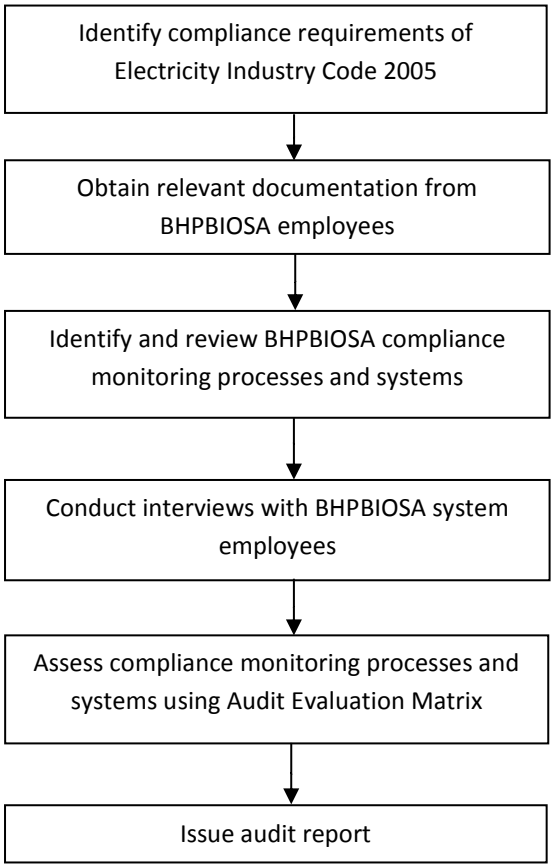
The audit scope covered the electricity network supplying the gazetted township of Newman, Newman Airport and the town water supply bore field. The electricity network supplying the mining infrastructures at Mt Whaleback Iron mine and all other mine leases in the surrounding of the township of Newman were not evaluated in the audit.

Refer to Appendix A for the geographical map of the township of Newman.

3. AUDIT METHODOLOGY

3.1.Audit Flowchart

The methodology applied to perform the audit is as per the following flowchart:



3.2.Audit Evaluation Matrix

The audit assessment was carried out as per the following procedures:

1. Review if BHPBIOSA have adequate systems, documented processes and guidelines, plans, and procedures in place to ensure compliance with each of the performance provisions defined in the Code. Assess the current monitoring processes and systems using the ten criteria shown in Table 1 below. Assign a performance ranking of Low, Medium, or High to each criterion.
2. Based on the ten performance rankings assigned, determine the overall compliance rating. The overall compliance rating indicates the effectiveness of the monitoring processes and systems in achieving compliance with each of the provisions.
3. Compare all overall compliance ratings with the preceding year's results. Improvements are measured in percentage. A 33% improvement means the overall rating has improved either from Low to Medium, or from Medium to High. An improvement from Low to High is equivalent to 66% of improvement.

Table 1 | Audit of compliance management systems and processes evaluation matrix

Item		Description	Description of Ranking		
			Low	Medium	High
1	Process	Documented Process	Process in place documentation requires further development	Process is documented	Strong documentation and may comply with ISO9001
2		Process fully integrated with corporate management systems	Requires development	Linkage with management reporting	Full integration with corporate IT system
3		Demonstration of operator understanding of the documented process	Training required	Employee understanding	Strong employee understanding and evidence of training systems
4		Evidence that the process is followed and records are kept as per process	Records available but not easily accessible or auditable	Adequate records available over full compliance periods	Auditable records available over full compliance periods with mandatory defined fields
5	Continuous Improvement	KPIs are in place	KPIs in place	KPIs are in place with some understanding by operators	Evidence that KPIs are in place and comprehensively understood by all operators
6		Reporting system supports continuous improvement	Requires development	Reporting systems exist at some levels	Reporting systems in place clearly showing gaps and trends of performance
7		Evidence action taken	Requires development	Evidence of reactive response	Evidence that gaps and trends are proactively actioned
8	Measurement Tools	Suitability of PQ measurement devices	PQ device has partial PQ functions and not fully compliant to AS61000.4.30	PQ device has full PQ functions but not fully compliant to AS61000.4.30	PQ device has full PQ functions and fully compliant to AS61000.4.30
9		Data collection methodology of the PQ measurement devices	Data manually extracted and analysed	Data extracted automatically over communications link. Data collection only.	Data extracted automatically over communications link with data analysis at the device.
10		Method of PQ measurement devices deployment	Portable devices not permanently fixed to the network.	Devices permanently installed on the network at strategic locations	Permanently fixed to the network and integrated into the network management control on a real time basis.
11		Overall Ranking	Refer to Table 2 for descriptions		

Table 2 | Overall compliance rating table

Overall Compliance Rating	Description	
	High	Best practice quality processes and systems
	Medium – High	Above average quality processes and systems
	Medium	Adequate quality processes and systems
	Low – Medium	Quality systems and processes require further development.
	Low	Quality systems and processes require major further development

4. AUDIT RESULTS

The audit assessed the performance and suitability of the compliance monitoring systems and processes that BHPBIOSA have in place to ensure compliance with each of the provisions under The Code's Part 2 Divisions 1, 2 and 3.

4.1. Part 2, Division 1 – Quality Standards - Section 6(2), 7 & 8 (a)(b)

Sections 6(2), 7 and 8(a) (b) relate to flicker, harmonics, voltage magnitude and frequency respectfully.

The following notes relate to the Code's PQ compatibility levels:

- According to Section 6(2), the voltage fluctuation of electricity supplied must not exceed the compatibility levels of P_{st}=1.0 and P_{lt}=0.8 set out in Part 3.7 clause 3 of AS/NZS 61000:2001.
- According to Section 7, the standard for the harmonic voltage distortion levels of electricity supplied is a distortion level that is less than the compatibility levels set out in a table in the same section.
- Under Section 2 of AS60038-2000 Standard Voltages, the voltage level of electricity supplied must be maintained at +10% and -6% of the nominal voltage of 230V single phase, or 400V three-phase.
- According to Section 8, the frequency must be maintained at +/- 2.5% of 50 cycles per second.

Appropriate process and system are required to identify and record any breaches of the compatibility levels, and to keep track of the remedies undertaken to eliminate the breaches.

Table 3 | Part 2 Division 1 Section 6(2), 7 & 8 (a) (b) - Evaluation Matrix

Item	Category	Description	Ranking			% of Improvement Compared to the Preceding Year Results	Comments
			Low	Med.	High		
1	Process	Processes in place and documented			1	50%	Note 1
2		Process fully integrated with corporate management systems			1	25%	Note 2
3		Demonstrated operator understanding of the process			1	0%	No change
4		Evidence that the process is followed and records are kept as per process		1		25%	Note 3
5	Continuous Improvement	KPIs are in place		1		0%	No change
6		Reporting system supports continuous improvement		1		25%	Note 2
7		Evidence action taken - continuous improvement		1		25%	Notes 1 & 2
8	Measurement Tools	Suitability of PQ measurement devices			1	0%	No change
9		Data collection methodology of the PQ measurement devices		1		0%	No change
10		Method of PQ measurement devices deployment	1			10%	Note 4
11		Overall Ranking		MH			

Note 1: The Inspection System Plan (ISP) has been updated from 2005 to 2016 Version. Also, a Manual on the ISP has been prepared by BHPBIO – currently under review for approval by Energy Safety.

Note 2: An automated system (i.e., software running on notebook) is under development to improve the inspection process and issue of defects/compliance issues. Also, reactive power and voltage control equipment are employed through the network to better control the voltage profile across the system.

Note 3: As evident by fault record information improvements have been made to be inclusive of more detailed information regarding network parameters at the time of faults. Also, a continuous trend is observed in the number of outages over the last 4 FYs; from 42 in 2012/13 FY through to 21, 14 and 8 outages in the next FYs, respectively.

Note 4: As evident by interviewee's comments and research BHPBIOSA are proactively seeking to obtain information regarding the installation of permanent PQ measurement devices at various locations within the Newman Township.

Audit Observations:

1. The BHPBIOSA employees that are involved in managing power quality understand the need to:
    - Ensure compliance with The Code's requirements;
    - Expeditiously rectify network disturbances that affect the quality of supply to customers; and
    - Extend the monitoring capability of the LV network.
2. It is evident that the fault record information has been improved from the previous year with the advent of information pertaining to the network voltage, accurate record of time, probable cause of fault investigation and general switching performed to reconfigure the network. However, there are still improvements that BHPBIOSA can make to this system, these improvements include:
    - Inclusion and labelling of planned outages on the 1Doc outage record. This information would provide a centralised reference location for all outages occurring throughout the Newman township network;
    - Inclusion of a column detailing the customers affected by locality, i.e. STS6 (45), TC3 (15). This information would prove useful in accurately calculating reliability indices and as a result planning future outages by proactively identifying areas of the network requiring prioritised improvements; and
    - Increasing the significant figures of the reliability indicator values, SAIDI and SAIFI, within the 1Doc outage record.
3. In the 2015/2016 period, BHPBIOSA has successfully continued the process of replacing ageing or defective pole top transformers; the implementation of this process is supported through standardised preferred distribution transformer rating and supplier.
4. The BHPBIOSA engineering team clearly demonstrate an exemplary understanding of the potential interferences that affect the power supply quality of the network.
5. BHPBIOSA demonstrated an understanding of the need to improve the monitoring capabilities of the network through permanent PQ monitoring of the LV network. The installation of permanent PQ monitoring systems would provide proactive monitoring for network quality and would give BHPBIOSA a greater visibility of network and adverse PQ events occurring close to (or being caused by) LV customers. The addition of permanent PQ monitoring could also change the current reactive response toward breaches of the power quality standards to a more effective proactive response, shifting away from breaches being identified from the logging period, or when a customer complaint is received
6. BHPBIOSA continue to utilise a retailing and billing contractor (MBC Global) to facilitate as a 24/7 customer call centre for complaints, as well MBC manages the retailing, billing and organisation of meter reading services. Complaints made through MBC are filtered through to BHPBIOSA as required. The number of power quality related complaints was nil which corresponds with the observed physical quality of the network supply.
7. Additionally, in 2015/16 FY the implementation of electronic billing has been offered to customers to eliminate the fees associated with printing and postage.
8. BHPBIOSA implemented a survey for new customers in May 2016 regarding customer satisfaction toward BHPBIOSA's electricity network and associated services. From this survey the main improvement opportunity presented is to inform customers of their electricity entitlements more effectively.

4.2. Part 2, Division 2 – Standards for the Interruption of Supply to Individual Customers, Section 9 & Section 10

Sections 9 and 10 relate to General Standard of Reliability; and Duty to Reduce Effect of Interruption respectively.

According to this provision, a transmitter or distributor must, *so far as is reasonably practicable*, ensure that the supply of electricity to a customer is maintained and the occurrence and duration of interruptions is kept to a minimum. According to this provision, it is not a breach of section 9 of the Code for BHPBIOSA to interrupt the supply of electricity to a customer for the purpose of maintaining or alter the network if the length of the interruption does not exceed 4 hours and BHPBIOSA have given notice of the proposed interruption to the customer not less than 72 hours before the start of the interruption. If it is not reasonably practicable to provide more than 72 hours of notice; notice should be given at the earliest practicable time before the start of interruption.

Table 4 | Part 2 Division 2 Section 9 & 10 - Evaluation Matrix

Item	Category	Description	Ranking			% of Improvement Compared to the Preceding Year Results	Comments
			Low	Med.	High		
1	Process	Process in place and documented			1	50%	Note 1
2		Process fully integrated with corporate management systems		1		25%	Note 2
3		Demonstrated operator understanding of the documented process			1	0%	No change
4		Evidence that the process is followed and records are kept as per process			1	0%	No change
5	Continuous Improvement	KPIs are in place			1	0%	No change
6		Reporting system supports continuous improvement			1	0%	No change
7		Evidence action taken - continuous improvement			1	0%	No change
8		Overall Ranking	MH				

Note 1: Customers notified 48hrs in advance for any planned outage. Also where possible, temporary diesel generation units employed to supply customers locally during the planned outage period.

Note 2: Improved outage planning process with prior notification to customers in place.

Audit Observations:

1. The BHPBIOSA employees interviewed continually demonstrate a clear understanding of their roles and responsibilities in maintaining supply reliability and minimising the duration and frequency of interruptions to the customers.
2. BHPBIOSA employees are conscious of network performance and appear to take an active and responsible stance to underperforming assets, including:
    - Replacement of six ageing and defective distribution transformers within the township;
    - Installation of an additional transformer with AVR/tap change capabilities at the Whaleback site to resolve voltage issues;
    - Resolution to a mal-grading issue of protection.

    Additionally, a preventative program to reduce the number of bird related outages has been successfully introduced which has significantly reduced the number of outages during the 2015/16 FY period.
3. BHPBIOSA continually undertake actions to further improve network reliability and strength with the following expected future implementations:
    - Installation of a new town feeder - STS4;
    - Extension and upgrade of an existing feeder - TC3; and
    - Installation of a new Ring Main Unit at the town shopping centre.
4. The BHPBIOSA employees demonstrate a clear understanding of the systems and processes involved in managing planned and unplanned outages.
5. BHPBIOSA has actively made the improvement of rostering two team members on call afterhours as an exercise to reduce response times for unplanned outages.
6. Currently working under the 2005 Inspection System Plan (ISP), BHPBIOSA has actively developed a new 2016 ISP and submitted the formal document to Energy Safety which currently awaits approval. An Inspection System Procedure Manual has also been created, which specifies the requirements and responsibilities of the employees involved in technical inspections of the new network installations.
7. The introduction of the Network Controller role in the previous financial year has been a successful implementation with the role enhancing the collaboration between electrical supervisors and engineering supervisors. As a result of this collaboration there has been a significant improvement in the fault recording and finding process over the 2015/16 FY.
8. Structural changes to the department have been implemented this financial year with the separation of the team into two divisions; Operation and Maintenance. In addition to this the employment of lead roles for each of the divisions has been introduced to ensure effective management of the day-to-day operation and maintenance of the township network.

4.3. Part 2, Division 2 – Standards for the interruption of supply to individual customers, Section 11; Section 12; and Division 3 Section 13

Sections 11, 12, and Division 3 Section 13 relate to Planned Interruptions, Significant Interruptions and Standards prescribed for particular areas respectively.

An appropriate system is required to record all the scheduled outages that BHPBIOSA plan to undertaken in each year. An efficient process should be in place for providing notifications to each of the customers that will be affected by planned interruptions in compliance with the provision.

Table 5 | Part 2 Division 2 Section 11, 12 & Division 3 Section 13 - Evaluation Matrix

Item	Category	Description	Ranking			% of Improvement Compared to the Preceding Year Results	Comments
			Low	Med.	High		
1	Process	Process in place and documented		1		33%	Note 1
2		Process fully integrated with corporate management systems		1		0%	No change
3		Demonstrated operator understanding of the documented process			1	0%	No change
4		Evidence that the process is followed and records are kept as per process		1		0%	No change
5	Continuous Improvement	KPIs are in place			1	0%	No change
6		Reporting system supports continuous improvement			1	0%	No change
7		Evidence action taken - continuous improvement			1	0%	No change
8		Overall Ranking	MH				

Note 1: BHPBIOSA actively provides customers the required 72 hours' notice prior to a planned interruption, as evident by sighting a notification delivered to customers for a planned outage.

Audit Observations:

1. As evident by sighting a notification delivered to customers for a planned outage as well as comments made during interviews BHPBIOSA employees demonstrate a clear understanding of the need to limit planned outages to 4 hours or less and to provide notifications to customers at least 72 hours prior to the start of work, in accordance to the Electricity Code 2005. Minor improvements on the current notification system would be to include:
    - The date for when the notifications were delivered; and
    - Implement a register of addresses where notifications have been distributed. This register can then be used for reference when the planned outage takes place. An additional benefit of such a register is to provide outage reporting the necessary level of detail, e.g. more accurately detail and record the number of customers affected by the outage.
2. Additionally, BHPBIOSA employees interviewed demonstrated a concise understanding of their responsibilities to remedy the causes of interruptions to small use customers or enter into alternative arrangements if the supply has been interrupted for more than 12 hours continuously, or more than the permitted number of times, in accordance to Electricity Code 2005.
3. As evident by interviewee's comments BHPBIOSA have portable standby generators in place to cater for extended planned interruptions, however comments stated that there is a need for additional generators on standby to more effectively handle the effect of extended outages.
4. BHPBIOSA are currently aware of 3 customers with special health needs which rely on electrical supply for life support. From sighting a notification delivered to customers for a planned outage, the responsibility of arranging and discussing an alternative supply is on the special health needs household. BHPBIOSA should actively aim to include this information into the planning of outages affecting these customers and takeover the responsibility to engage and provide an alternative supply for these customers.

5. CONCLUSION

The audit interviews where undertaken on the 13th July 2016 at BHPBIOSA's Newman offices; all relevant stakeholders made themselves available for the audit process. The general demeanour of the office continues to remain one of professionalism and commitment to their roles; and it was noted by numerous interviewees that positive change within the business had occurred since the previous reporting period.

Within the 2015/16 reporting period the most significant improvement was the positive revision of the fault logs within the 1Docs System. These improvements encompassed the addition of detailed information, including; network voltage, accurate record of fault time, probable/exact cause of fault and the overall switching performed to reconfigure the network. The inclusion of this information has given BHPBIOSA a greater understanding of the cause and location of outages within the network, as well as allowing for more proactive planning toward asset management and replacement.

BHPBIOSA continue to demonstrate a pro-active response to improving the reliability of Newman's electrical network. This proactive response is evident from the strategic replacement of underperforming equipment as well as installation of assets to improve network capacity. For example, 6 distribution transformers were replaced as well as the installation of an additional transformer at the Whaleback site. In addition to these replacements and installations, the correction of mal-grading protection was resolved. It should be noted that these improvements will have a significant effect on improving reliability indices.

With respects to the holistic electrical network, the recent PQ metering data indicates that Newman's electrical network has undergone noteworthy improvements to maintain its reputation as a robust and inherently good network. The basic electrical parameters of voltage, frequency and voltage total harmonic distortion were consistently stable and well within compliance-levels. There were a very limited number of instances (i.e. under 0.1% of the measurement period) where the maximum magnitude of certain electrical parameters was found to exceed the limits prescribed by the Code. However, this is not deemed as a major compliance issue due to the temporary and extremely isolated nature of the instances. Although, it is recommended that BHPBIOSA still investigate such events.

There are 2 main areas where BHPBIOSA can make improvements:

- Accurate and consistent documentation of planned and unplanned outages; including detailed documentation of the localities affected by each outage, merging planned and unplanned outages into the 1Doc outage records. The execution of this improvement would enable BHPBIOSA to optimise reliability indices which are later used for network planning decisions and performance reporting. This point is further discussed in Section 6 of this report.

- Permanent PQ monitoring of the LV network in order to ensure compliant supply at the customer's point of connection as per Part 2 Section 5 of the 2005 Electricity Code. This point is further discussed in Section 6 of this report.

6. RECOMMENDATIONS

The following recommendations have been partitioned into recommendations pertaining to:

1. Service reliability;
2. PQ monitoring;
3. Customer relations;
4. Planned outage notification;
5. Customers and their distribution throughout the network.

6.1. Outage Event Recording System

During the 2015/16 FY significant improvements were made in relation to implementing a process to effectively record information relating to unplanned outage events, these improvements included the implementation of:

- Accurate recording of outage time;
- Network voltage level of the outage event;
- Results of fault investigation; and
- Switching events performed to reconfigure the LV network.

In addition to these previous improvements it is recommended that:

1. Planned outages are included on the 1Doc outage record; the inclusion of this information will better provide a centralised location for all outages with the means to accurately calculate reliability indices which are later used for network planning decisions and performance reporting.
2. Inclusion of detailing the customers affected by an outage by locality, i.e. STS6 (45), TC3 (15), within the 1Doc outage record. This information would prove useful in accurately calculating reliability indices and as a result planning future outages by proactively identifying areas of the network requiring prioritised improvements.
3. Increase the degree of accuracy of the values for the reliability indices, SAIDI and SAIFI, within the 1Doc outage record the. Increasing the degree of accuracy for these values will present useful information when comparing and assessing the reliability indices for network planning decisions and performance reporting.

6.2. Power Quality Monitoring System

It is evident that the PQ of the sub-transmission network is adequately monitored via dedicated DIgSILENT PQ monitoring devices and to a lesser extent statistical metering (via SCADA) and the oscillography recording capabilities of protection relays. As per Part 2 Section 5, the power quality *at the point of connection* should comply with prescribed PQ compatibility levels, yet there is little visibility of the PQ within the LV distribution network.

It is recommended that BHPBIOSA continue to investigate opportunities to implement permanent PQ monitoring within the LV network. As previously recommended the implementation of a small pilot scheme would be beneficial where 1 smart meter is installed at the end of each of the 7 feeders

in order to gain some visibility into the PQ at the extremities of the LV network. This recommendation continues to stay in place with the following accompaniments:

1. Power quality devices are compliant to AS61000.4.30.
2. The viability of permanently installed PQ meters in future pad-mounted substations is investigated.
3. A record system be developed to keep track of non-compliant power quality issues on a regular basis so that the engineering team can carry out investigations and implement adequate solutions in a timely manner, rather than relying on customer complaints to initiate an inquiry.

An expansion of this recommendation would be to include PQ monitoring into the future installation of STS4 and expansion of TC3. These upgrades present the ideal opportunity to integrate PQ monitoring during construction.

6.3. New Customer Survey Feedback

From the feedback of the survey implemented in May 2016, it is recommended that BHPBIOSA:

1. Implement a process to completely inform all customers of their electricity entitlements, inclusive of their entitlements to an alternative supply for extended outages and compensation for interruptions exceeding 12 hours. Detailed information regarding how customers apply for compensation should be included. This improvement could be effectively implemented via physical media, such as delivering a pamphlet style notification to each household annually, as new customers connect to the network or as entitlements change.
2. Engage MBC Global to simplify billing invoices. Complaints from the 2014/15 and 2015/16 FY related to billing, simplification of billing invoices could potentially alleviate these complaints.
3. Engage MBC Global to ensure concerns regarding meter reading are promptly responded to prevent further billing complaints.

These improvements would strengthen the relationship between BHPBIOSA and its' customers of which most are BHPBIO employees.

6.4. Planned Outage Notifications

It is recommended that:

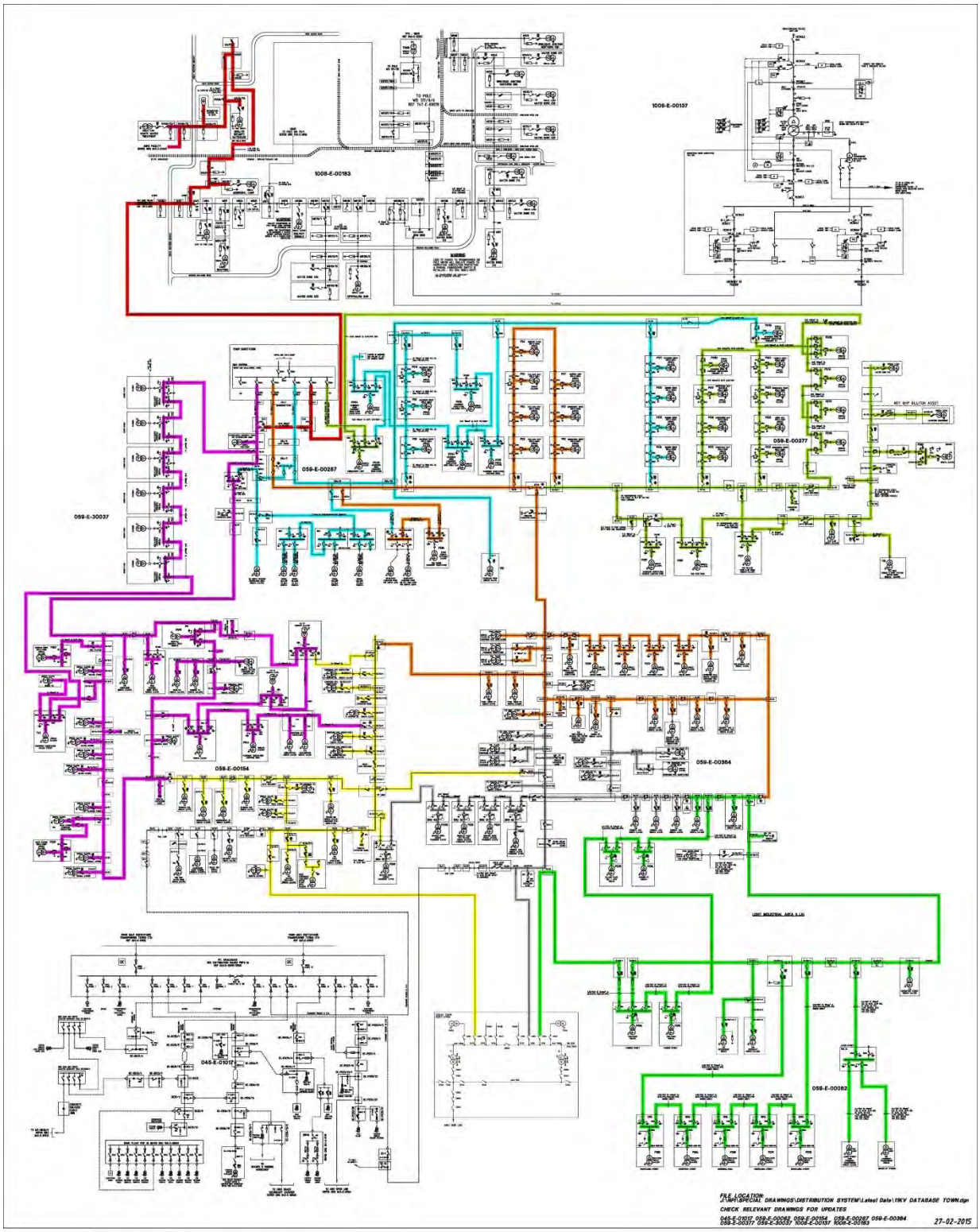
1. The date for when planned outage notifications were delivered is recorded or included on the delivered information. This information allows for accountability of the requirement to notify customers at least 72 hours prior to a planned outage.
2. A register of addresses where notifications have been distributed is implemented. This register can then be used for reference when the planned outage takes place. An additional benefit of such a register is to provide outage reporting the necessary level of detail, e.g. more accurately detail and record the number of customers affected by the outage.
3. Where practical, temporary diesel generation units to be employed to supply the local customers during the planned outage period.

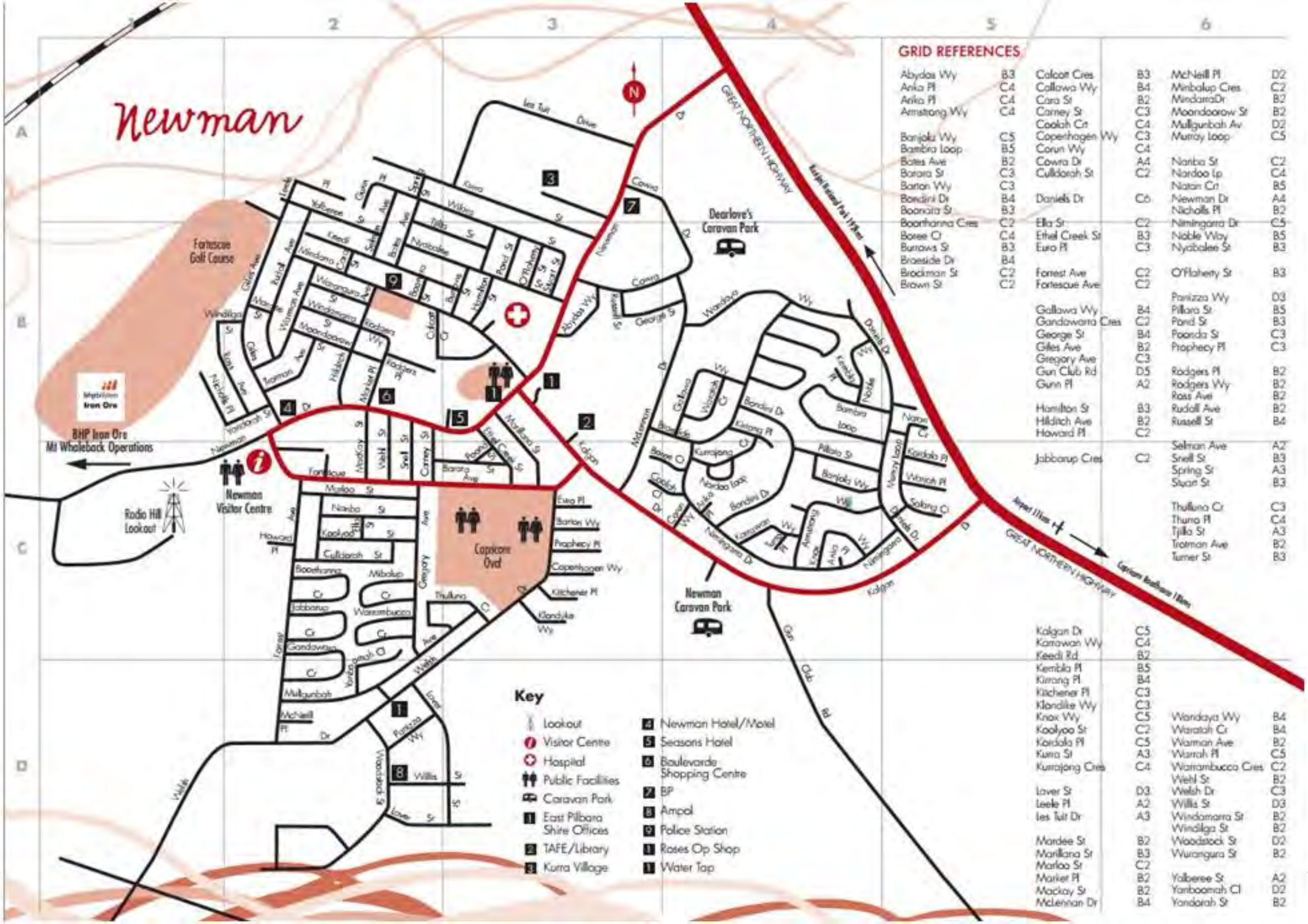
6.5. Total Number of Customers and Their Distribution Throughout the Network

It is recommended that:

1. BHPBIOSA implement a process and/or a record system to keep track of the number of customers being supplied by each of the township feeders. This could be simply and effectively implemented within the BHPBIOSA record of customer details.
2. The electronic CAD or DGN copy of the township electrical reticulation plan be updated whenever a new customer or network equipment is connected to the network, or when the open points on the network are altered. Each premise on the site plan should be annotated with the name of the supply transformer with each 11kV feeder identified with a unique colour.

APPENDIX A Newman Township (SLD & Map)





Newman
Fortescue Golf Course
BHP Iron Ore Mt Whaleback Operations
Radio Hill Lookout
Newman Visitor Centre
Dearlove's Caravan Park
Newman Caravan Park
Capricorn Oval
GREAT NORTHERN HIGHWAY
Key
Lookout
Visitor Centre
Hospital
Public Facilities
Caravan Park
East Pilbara Shire Offices
TAFE/Library
Kurra Village
Newman Hotel/Motel
Seasons Hotel
Boulevarde Shopping Centre
BP
Ampol
Police Station
Roses Op Shop
Water Tap
GRID REFERENCES
Abydos Wy B3
Anka Pl C4
Arika Pl C4
Armstrong Wy C4
Banjolu Wy C5
Bambra Loop B5
Bates Ave B2
Barara St C3
Barton Wy C3
Bondini Dr B4
Boonara St B3
Boorthanna Cres C2
Boree Cr C4
Burrows St B3
Braeside Dr B4
Brockman St C2
Brown St C2
Colcott Cres B3
Callawa Wy B4
Cara St B2
Carney St C3
Coolah Crt C4
Copenhagen Wy C3
Corun Wy C4
Cowra Dr A4
Culldorah St C2
Daniels Dr C6
Ella St C2
Ethel Creek St B3
Euro Pl C3
Forrest Ave C2
Fortescue Ave C2
Gallawa Wy B4
Gandowarra Cres C2
George St B4
Giles Ave B2
Gregory Ave C3
Gun Club Rd D5
Gunn Pl A2
Hamilton St B3
Hilditch Ave B2
Howard Pl C2
Jabbarup Cres C2
Kalgan Dr C5
Karrawan Wy C4
Keedi Rd B2
Kembla Pl B5
Kirrang Pl B4
Kitchener Pl C3
Klondike Wy C3
Knox Wy C5
Koolyoo St C2
Kardala Pl C5
Kurra St A3
Kurrajong Cres C4
Laver St D3
Leele Pl A2
Les Tuit Dr A3
Mardee St B2
Marillana St B3
Marloo St C2
Market Pl B2
Mackay St B2
McLennan Dr B4
McNeill Pl D2
Minbalup Cres C2
MindarraDr B2
Moondoorow St B2
Mullgunbah Av D2
Murray Loop C5
Nanba St C2
Nardoo Lp C4
Natan Crt B5
Newman Dr A4
Nicholls Pl B2
Nimingarra Dr C5
Noble Way B5
Nyabalee St B3
O'Flaherty St B3
Panizza Wy D3
Pillara St B5
Pand St B3
Poonda St C3
Prophecy Pl C3
Rodgers Pl B2
Rodgers Wy B2
Ross Ave B2
Rudall Ave B2
Russell St B4
Selman Ave A2
Snell St B3
Spring St A3
Stuart St B3
Thulluna Cr C3
Thurra Pl C4
Tjilla St A3
Trotman Ave B2
Turner St B3
Wandaya Wy B4
Waratah Cr B4
Warman Ave B2
Warrah Pl C5
Warrambucca Cres C2
Wehl St B2
Welsh Dr C3
Willis St D3
Windamarra St B2
Windilga St B2
Woodstock St D2
Wurangura St B2
Yalberee St A2
Yarrboomah Cl D2
Yandarah St B2