WHEATBELT SNAPSHOT SERIES: POWER AND ENERGY

Version 1 – July 2014

DISCUSSION PAPER OVERVIEW

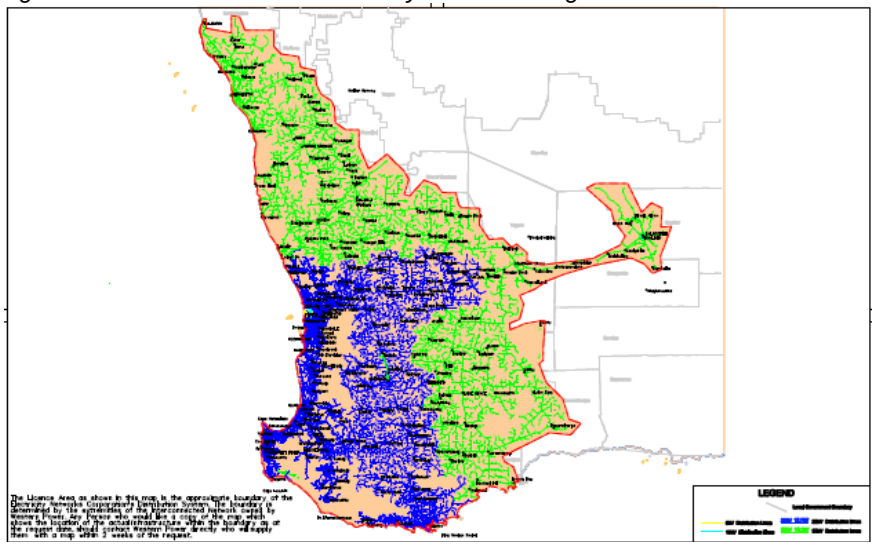
The purpose of this document is to summarise the state of power and energy infrastructure in the Wheatbelt Region and identify key development issues. This document highlights the issues and limitations of existing infrastructure and identifies some of the identified short term capital works plans.

Adequate power infrastructure is vital for industry and population growth in the Wheatbelt. Energy in the Wheatbelt (see figure 2) is supplied by the South West Interconnected System (SWIS), through the South West Interconnected Network (SWIN).

Figure 1 Phases of electricity supply in Western Australia (Western Power 2012)

The SWIN is a self contained system, unlike major urban areas elsewhere in Australia which are powered through interconnected networks such as the National Electricity Market (NEM). This means the system has no outside support or backup.

Figure 2 South West Interconnected System Licensing Area Distribution



Development Issues

The *Draft Wheatbelt Land Use Planning Strategy* highlights that although energy infrastructure has a certain target capacity, energy is supplied incrementally in order to minimise costs and increase efficiencies.

In regions such as the Wheatbelt, only 50 to80 per cent of existing capacity is currently utilised. In order for an upgrade to occur, increased demand that places current infrastructure at full capacity would need to be demonstrated.

Key development issues in the Wheatbelt region include:

- Ability to address cost barriers for connection to power infrastructure for new developments (residential, commercial and industrial)
- Scheduling of upgrades to ageing power infrastructure
- Efficient response to power outages and reliability issues.
- Staged, trigger point investment plans for capital investment in power supply in the Wheatbelt endorsed by government for out-year State budget allocation
- Connection cost and capacity restraints in the distribution network are inhibiting the development of energy generation in the region. This is limiting the regions ability to contribute to the renewable generation market (wind, solar etc).

GENERATION:

Verve Energy produces approximately 60 per cent of the electricity in the Western Australian market.
Base load generation (gas, coal and distillate) is concentrated in the South West, with major power stations in Collie, Kwinana, Cockburn and Pinjar. (refer to Appendix 1 for other power generators in WA).

Generation capacity in the Wheatbelt is generally through renewable energy, particularly wind farms. Generation capacity in the region includes:

- Emu Downs Wind Farm, Cervantes (79.2MW)
- Collgar Wind Farm, Burracoppin (206MW)
- Merredin Energy (diesel), Merredin (82MW)

The Wheatbelt has considerable renewable energy opportunities, however there are challenges associated with integrating high levels of new and often intermittent renewable energy generation into the State's main electricity grid.

As identified in the *Draft Wheatbelt Land Use Planning Strategy*, large scale renewable plants are likely to be restricted to areas in close proximity to existing and planned high voltage power lines. Small scale renewable distributed generation is likely to be restricted to off-grid installations as the capacity of the local power distribution network limits their ability to feed power back into the grid.

There are a number of large scale renewable generation projects currently proposed for the region including:

- Badgingarra Wind Farm: APA Group (130MW)
- Joanna Plains Wind Peaker Project: Griffin Energy (106 MW duel fuel gas turbine power station)
- Dandaragan Wind Farm: Wind Prospect (513MW)

Additionally there are a number of proponents investigating alternative generation technologies utilising biomass in the region. The cost of connection is a significant barrier for these smaller scale projects.

Figure 3 Verve Energy power generators (Verve Energy 2012)

TRANSMISSION

Western Power is the owner and operator of the electricity transmission network in the South West, the South West Integrated Network (SWIN). Transmission constraints in the network are usually related to:

- Insufficient thermal rating
- Fault levels approaching equipment limits
- Lack of voltage support

Transmission infrastructure in the Wheatbelt is included in the following load areas:

- East Country
- Muja
- North Country

East Country Load Area

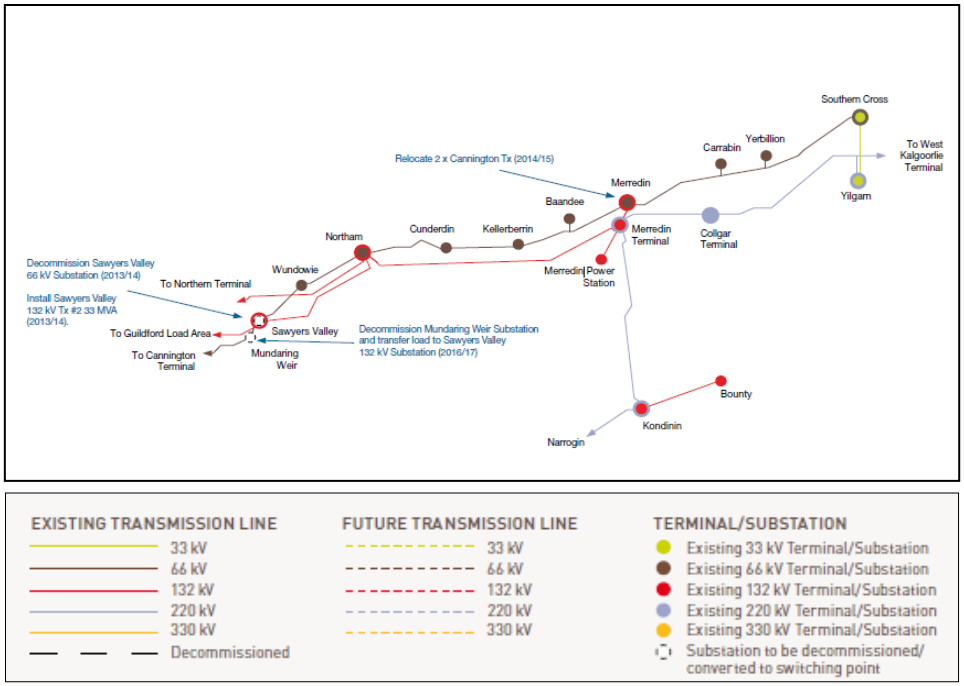
<u>Supply and Capacity:</u>

The East Country Load Area supports local loads as well as providing a link east through to the neighbouring Eastern Goldfields Load Area from the Muja and Guildford Load Areas. The transmission network is connected by:

- 132 kilovolt (kV) lines to the Northam Terminal and Guildford load areas
- 220kV lines to the Muja and Eastern Goldfields load area
- 66kV line to the Cannington load area

Traditionally the East Country Load Area has not had local generation, however with new entrant generation such as Collgar Wind Farm, the region is now a net generation exporter in some conditions.

Figure 4 East Country Load Area (Western Power 2012)



Consumption and Demand:

Western Power does not forecast any transmission fault limits or thermal limits in the Eastern Country Load Area in the next 5 years. This is assisted by Collgar Wind Farm's contribution.

Identified upgrades by Western Power include:

- An additional 132/22kV transformer for the Sawyers Valley Substation by 2012/13 to accommodate the Water Corporation's expansion of Mundaring Weir.
- Load forecasts indicate that the capacity of the 132/66kV Merredin Terminal Substation will be exceeded in summer 2012/13. This is likely to be addressed by the relocation of redundant transformers from Cannington Terminal.
- Rebuild of the Cannington Terminal-Mundaring Weir-Sawyers Valley-Wundowie-Northam 66 kV line to 132 kV after 2020.
- Construction of a Muchea to Northam 132 kV line to provide supply for the Toodyay and Chidlow area by 2030.

Muja Load Area

The Muja Load Area is connected to the Perth metropolitan area and Bunbury Load Area via a 330kV transmission network. There is also a single 220kV transmission line from Muja Terminal that supplies Narrogin South Terminal and then continues to the Eastern Goldfields.

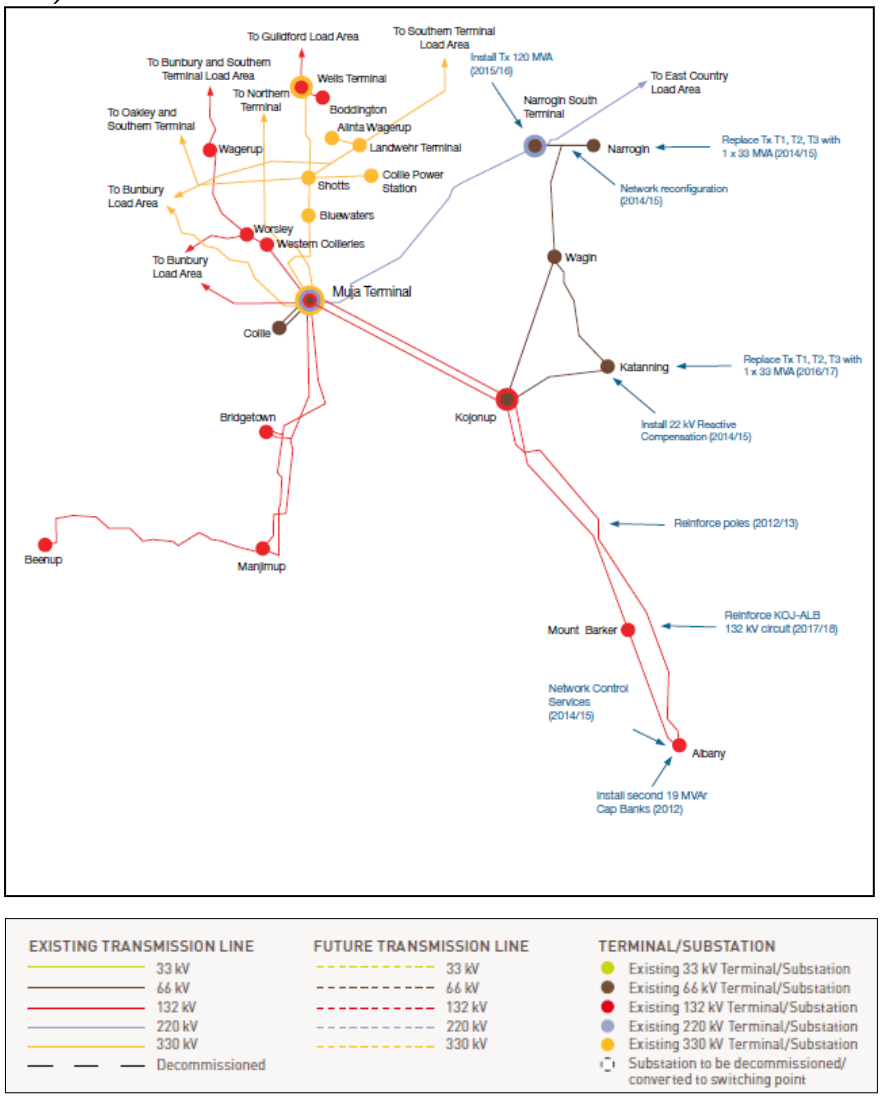
Consumption and Demand:

The Muja load area is geographically vast and home to an abundance of fuel resources (especially coal) which provide for the bulk of base load generation capacity in the Western Power Network. As a result, transmission network security and reliability servicing neighbouring load areas is paramount.

Few thermal or voltage limits, substation capacity, or fault levels have been identified by Western Power in the areas affecting the Wheatbelt. However there are numerous generation connection enquiries which may increase fault levels as they are commissioned.

Western Power has not listed any Wheatbelt projects in their committed projects in the Muja Load Area.

Figure 5 Muja Load Area – preferred transmission solutions (Western Power 2012)



Identified required upgrades by Western Power include:

- To address poor asset condition and projected capacity issues by 2020, three transformers at Narrogin Substation will be replaced with a single higher capacity transformer by summer 2014/15.

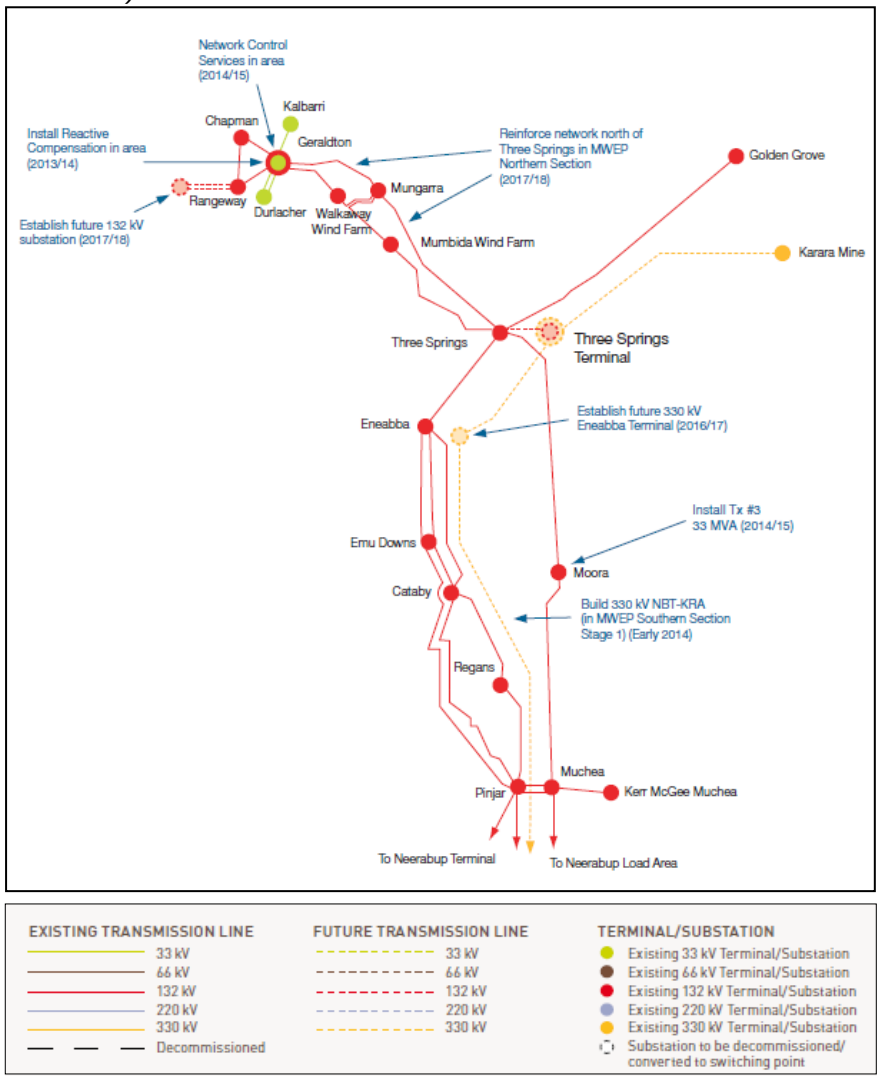
- The installation of a second 120 MVA transformer at Narrogin South Terminal has also been scheduled for Summer 2015/16.

North Country Load Area

<u>Supply and Capacity:</u>
The Country North Load Area spans 450km from the northern outskirts of Perth to north of Geraldton. The network has evolved to supply small loads distributed over a large geographical area. As a result the network is electrically weak and has limited capacity to supply load.

This system comprises of a number of 132kV transmission lines connecting to Perth via Pinjar power station. The system is also supported by locally connected generation including gas, diesel, and wind fuelled power stations located within the Wheatbelt and Mid West regions. The output of these power stations is used to provide voltage support and to supplement the limited capacity of the transmission lines.

Figure 6 Country North Load Area – preferred transmission solutions (Western Power 2012)



Western Power has received considerable interest for new entrant generation connections in the Country North Load Area. The coastal location between Pinjar and Geraldton provides a very prospective wind resource with wind load factors well in excess of 40 per cent (compared with approximately 30-40 per cent in most locations nationally) and relatively straightforward access to land. Western Power currently has enquiries from proponents seeking to develop over 1,300 MW of wind generation projects in this locality. The Shire of Dandaragan currently has renewable energy project proposals valued at over $1 billion. Land availability and sunshine hours also means this area is ideal for solar thermal energy production.

<u>Consumption and Demand:</u>

The current Country North Load Area transmission network does not have the capacity to meet the forecast electricity needs of existing and prospective customers. Substation capacity, thermal overloads and voltage constraints have been identified in this network. In addition, a number of major resource project proposals exist within the region requiring substantial power supply.

The Wheatbelt and Mid West areas covered by the Country North Load Area are recognised as being a major prospective contributor to the renewable generation market in Western Australia. However development of renewable technologies is constrained by the transmission network. This is particularly relevant to market generators intending to earn income from the reserve capacity and energy markets.

Although generators providing network control services could be accommodated, these generators would be dispatched only as required to support the local area load and may not be able to participate in the wholesale energy market or earn reserve capacity payments. Under these circumstances the cost of energy supplied from such power stations would necessarily be high.

The Mid West Energy Project (MWEP) Southern Section goes some way towards addressing these issues and will transform the region's future development prospects.

The MWEP include:

- A new double circuit 330 kV transmission line between Pinjar and the future Eneabba terminal substation,
- Conversion of the existing Neerabup – Pinjar line to 330 kV
- New 330/132kV terminal at Three Springs
- Double circuit 330kV line between Eneabba and Three Springs terminal

The MWEP southern section was approved as part of the state government's budget announcement in May 2012. It is one of the largest and most significant infrastructure projects undertaken in WA. It is scheduled for completion in 2014 and will provide additional supply for Mid West communities and allow the connection of substantial new wind generation projects.

No significant fault levels have been identified however with the numerous generation connection enquiries, faulty levels could increase.

Planned projects:

- Installation of a third 132/22kV transformer at Moora substation (2014/15)
- Establish Eneabba terminal to allow new entrant generation connection (Summer 2016/17)
- Construction of a new zone substation in the North Country (2017/18).

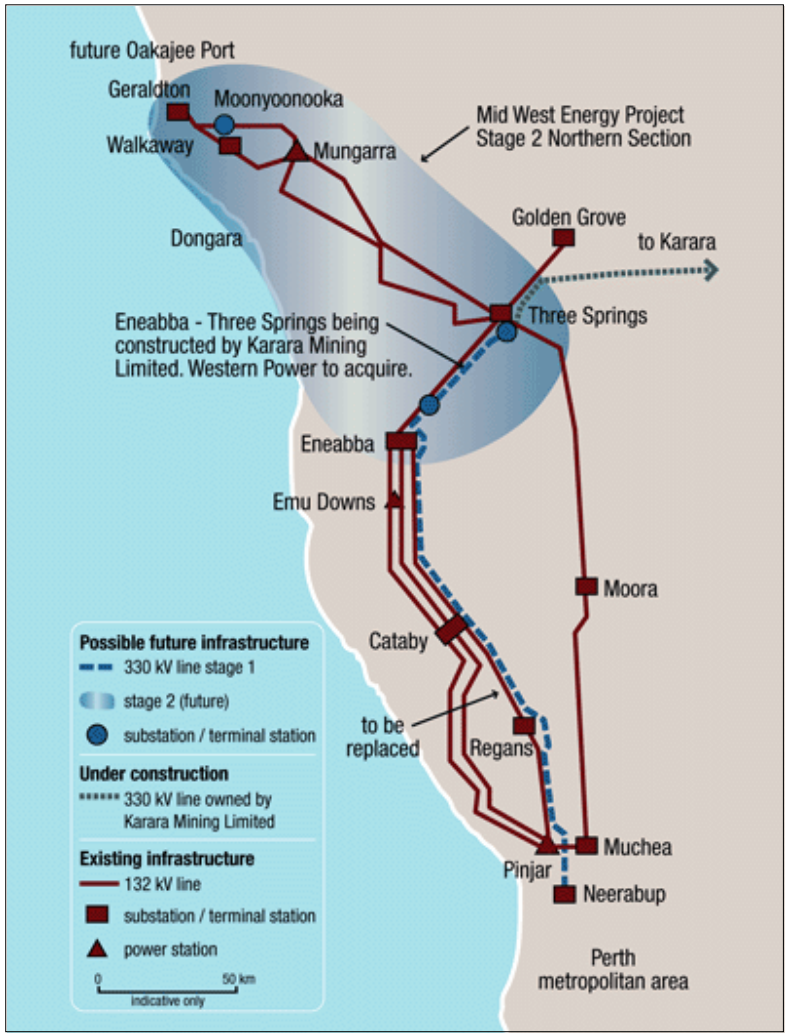
Karara Mining are building new lines between Three Springs and their Mid West mining sites to connect to this new infrastructure. Discussions are also in progress with Asia Iron.

Current plans are that the double circuit section of the line will initially be operated with one circuit at 132 kV and the other at 330 kV. When additional capacity is required to meet mining loads or additional generation, the line can be operated with both circuits at 330 kV. Line construction is due to start in mid 2012 for a February 2014 target completion date. Funding is being sourced for Stage 2 which will extend line connection to Moonyoonooka (Geraldton).

The SuperTowns planning activity in Jurien Bay identified the following constraints and opportunities:

- Spare power capacity will only provide power for very short term growth so capacity would need to be increased, particularly if increased commercial type developments occur.

Figure 7 Mid West Energy Project (Western Power 2012)



DISTRIBUTION (SUPPLY)

Western Power services the Wheatbelt's sub-regions as follows:

Network	Wheatbelt Sub-Region	Other Regions
Country East	Avon Central East Central Midlands (part) Wheatbelt South (part)	Goldfields
Country South	Wheatbelt South (part)	Great Southern South West
Country North	Central Coast (part) Central Midlands (part)	Midwest
Metro North	Central Coast (part) Central Midlands (part) Avon (part)	Perth

Refer to Appendix 2 for a list of Wheatbelt local governments and their Western Power Region.

Primary issues with supply include:

- Shortfall of zone substation power capacity
- Thermal constraints limiting capacity to supply or transfer loads between substations
- Voltage regulation constraints, voltage imbalance

Over head distribution networks dominate in the Wheatbelt with some underground lines in towns. All new residential and commercial subdivisions must have underground distribution.

Figure 8 South West Interconnected System (Western Power 2012)

SWIS Country East

Supply and Capacity:

The Country East distribution network was designed to accommodate the low load densities associated with agriculture and water pumping. Residential, commercial and light industrial loads also exist, as do mining loads in the eastern parts.

There are 10 Substations feeding the Country East Region at either 22kV or 33kV. The 22kV cluster is serviced by a 91 MW transformer capacity and the 33kV cluster is serviced by 88MW transformer capacity.

Western Power has identified that load growth in localities such as York, Toodyay, and Nungarin will cause feeders in the 22kV cluster to approach thermal capacity.

The primary constraint in the region is voltage regulation and limited line inter-connections due to the long radial nature of the local distribution network. These issues can be mitigated by:

- Conversion of existing single phase spurs into 2-phase or 3-phase
- Installation of an isolation transformer at the beginning of the heavily loaded single phase spur
- Installation of voltage regulators on the required feeder backbones

Consumption and Demand:

A large portion of customers are supplied from single phase rural distribution lines. Significant block loads such as mining, water

pumping, grain handing facilities and processing plants often require major reinforcement and extension of 3-phase power lines. A number of local governments in this area, particularly those located at the end of the network report reliability and response times to be an issue. Many towns use generators to reduce the effect of power outages (e.g. hospitals, doctors, shire offices).

Western Power deems the current transformer capacity to be sufficient for the next 5 years. Load demand in the country east 33kV cluster has remained steady. Load growth in some localities within this cluster will cause feeders to reach thermal capacity.

Recently completed Wheatbelt Country East Load Area projects from Western Power include:

- Trayning regulator to provide additional voltage capacity within the Trayning township and surrounding areas
- Bakers Hill regulator to provide additional voltage capacity within the Bakers Hill township and surrounding areas
- Country East Substation – isolation transformer installation to improve network imbalance issues in the network

Identified required upgrades by Western Power include:

- Hyden regulator to improve voltage profile and increase capacity, Summer 2012/13
- Single phase upgrade in the Toodyay East area, Winter 2013
- Isolation transformers to minimise feeder load imbalance in the York, Toodyay East and Wooroloo pump area, Winter 2013
- Rectify protection reach issue on feeders in the York and Goomalling areas, Winter 2013

As part of the *Draft Wheatbelt Land Use Planning Strategy* and SuperTowns planning process the following power requirements have also been listed for the Country East Load Area:

- Capacitor upgrades to Northam substation by 2014
- Conversion of Wundowie substation to 132 kV, operation by 2017
- Construction of two new zone substations at Toodyay and Chidlow by 2030

Figure 9 Country East Planning Region (Western Power 2012)

SWIS Country South

Supply and Capacity:

This Country South region can be divided into two study areas:

- The South West study area supplying the large urban centres on the coast from Pinjarra to Augusta.
- The Great Southern study area supplying the broad acre low density networks to the east of the South West study area. This includes the Wheatbelt region.

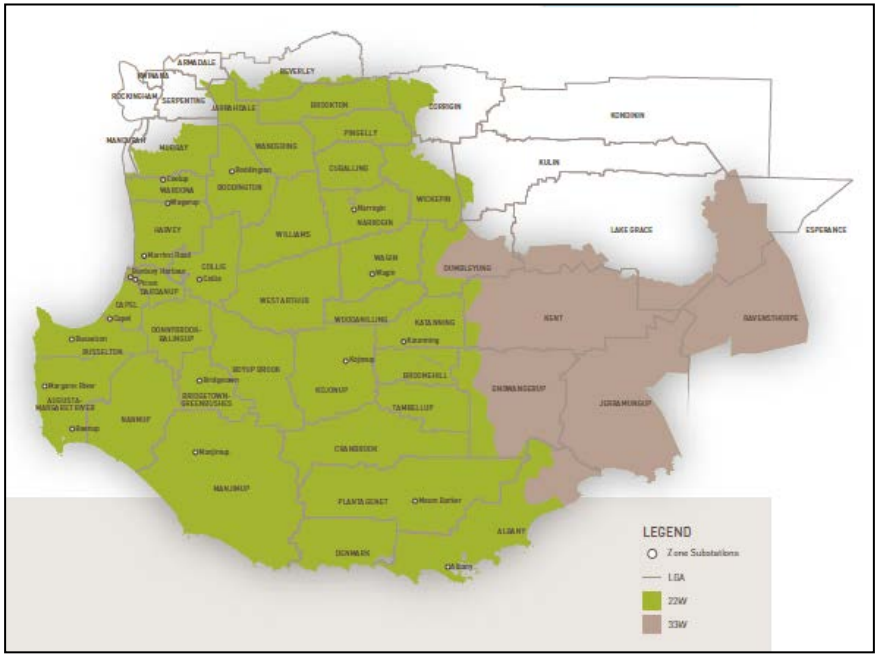
The supply networks in this region are generally radial, rural power lines. Rural feeders are subject to lower reliability service standards due to their large exposure to environmental conditions.

There are 19 substations feeders each of 22kV. Voltage capacity in the eastern section is increased to 33kV to allow loads to be supplied over larger distances. The combined substation capacity of this study area is 201 MW. Substation interconnections exist however capacity constraints limit opportunities for load transfer.

Consumption and Demand:

The load profiles in the Great Southern study area are generally small and dispersed, serving broad acre agricultural land uses. The exceptions are the networks of larger towns such as Narrogin, which are shorter and more heavily loaded. The long radial distribution networks were not designed to cater for loads above typical broad acre rural supply. This has become apparent in Boddington where mining growth has altered load characteristics. There has been minimal load growth elsewhere.

Figure 10 Country South Planning Region (Western Power 2012)



Due to the extremely long and lightly loaded distribution networks, the supply voltage has been increased from 22kV to 33kV at points along the feeders at four distribution substations, including Dumbleyung from the Wagin zone substation. Local governments with industrial activity (e.g. processing plants) do experience light disturbances in power with the increased local loads. A number of local governments are interested in increasing the use of solar panels for local power generation.

The SuperTowns planning activity in Boddington highlights capacity issues in Williams and Wandering. Both towns are fed from the Narrogin substation.

Edge of grid power stations present opportunities to increase capacity as well as address reliability problems experienced by communities located at the end of long radial feeders.

Identified required upgrades by Western Power include the replacement of three existing transformers at Narrogin substation by a single higher capacity unit by 2014/15.

SWIS Country North

Supply and Capacity:

The Wheatbelt area is supplied by the Country North 33 kV planning cluster. There are 5 substations feeding this cluster and similarly to other Wheatbelt areas, the networks consist of radial, overhead power lines. The power transformer capacity of the substations supplying the Country North 33kV cluster is 109MW. This is sufficient capacity to meet demand over the next 5 years, except at the Moora substation where demand will be exceeded the summer of 2013/14.

The SuperTowns planning activity in Jurien Bay identified the following supply characteristics:

- 2MVA spare capacity in Jurien Bay on the existing network, which is capable of supplying 400 additional residential properties based on an After Diversity Maximum Demand (ADMD) of 5kVA per lot.
- Cervantes has an increase of 800kVA that is capable of supplying 160 additional residential properties.
- Any commercial developments will erode this capacity relatively quickly.
- Land has been identified for a 132/33kV Zone Substation in the area to service a population of up to 20,000 people. This transmission solution for Jurien Bay will provide benefits for Cervantes, however, the power line to Cervantes will still be on an end of a spur line with limited interconnection.
- New 33kV aerial power line from Green Head to Jurien Bay
- New 33kV aerial power line from Eneabba to Jurien Bay

A number of local governments in this zone have reported that while there is adequate power supplied to their towns, the capital cost for new commercial and residential developments to connect is high enough to be a constraint to projects. This is largely related to the quality of local power infrastructure within town sites. Western Power have not provided any constraints or limitations on providing future supply, however, it is likely the growth of this area may be stalled if commitments are not made regarding the point at which upgrades will be undertaken.

Consumption and Demand:

The network supplies residential and industry loads servicing the horticulture, agriculture, fishing, port, mining and tourism activities in the Wheatbelt and Mid West. The loads are generally summer peaking being driven by water pumping, air conditioning or cool storage.

Western Power has identified that the Moora substation will exceed capacity by summer 2013/14. This is likely to require the installation of a new transformer and associated distribution feeder works given the distance between interconnected substations and the inability to transfer load. Similar to other load areas, extensions of 3-phase power lines in Country North is also identified.

Identified required upgrades by Western Power include:

- Transformer overload upgrade in winter 2012

SWIS Metro North

Supply and Capacity:

This planning sector is bound by the Swan River and CBD Planning Sector in the south, the Vines development in the east, Gingin in the north, and Guilderton in the west. There are a number of different voltage areas in the planning cluster however the Wheatbelt is supplied by the Metro North 22Kv (B). The 22kV network is separated into two zones because Whiteman Park acts as a physical barrier, preventing interconnections between zone substations in clusters A and B.

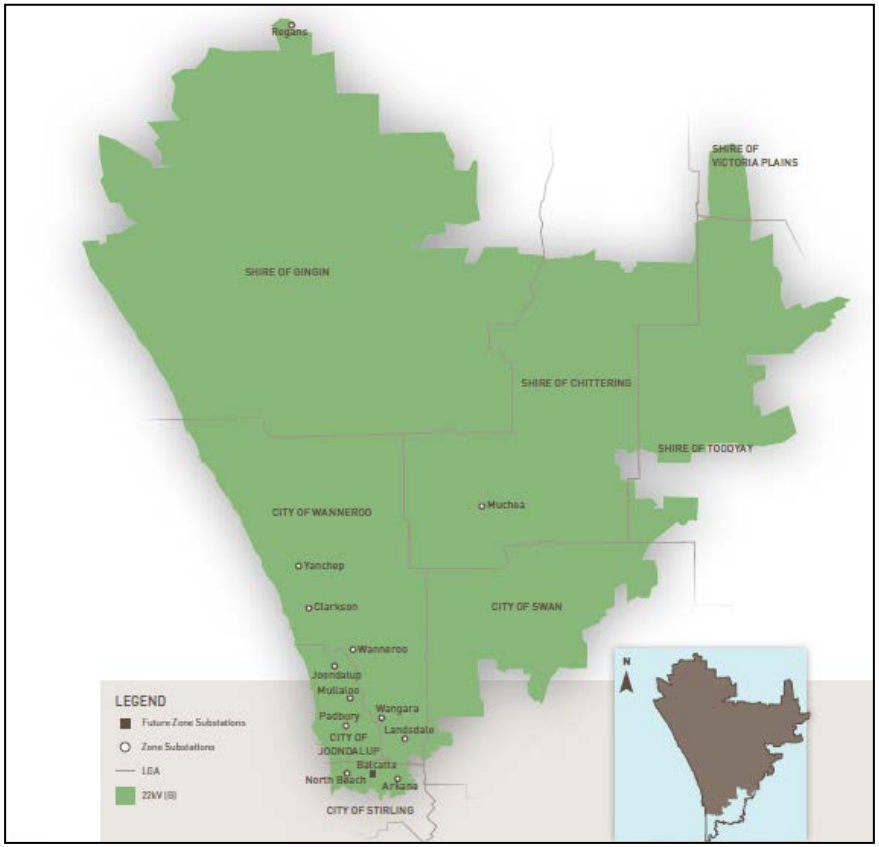
The Wheatbelt local governments of Gingin, Toodyay, Chittering and Victoria Plans have areas covered by this zone.
The outer fringes of this cluster mainly comprise of semi rural loads with a predominance of long overhead, typically voltage constrained feeders.

There are 12 substations in the cluster, 3 of which are located in the Wheatbelt (Yanchep, Muchea and Regans 22kV). The combined zone substation capacity supplying the cluster for summer 2011/12 was 694MW. This cluster forms part of the Neerubup Terminal Load Area. This terminal is strategically important for the connection of the MWEP as well as the future development of transmission infrastructure to the North Country Load Area.

Consumption and Demand:

All committed works in this cluster are located in the Perth Metropolitan area. There is consistent urban load growth in the south of the cluster to justify a new substation in Balcatta in 2013/14 and a second transformer at the Joondalup substation in 2012/13.

Figure 11 Western Power Metro North 22 kV (B) Planning Region (Western Power 2012)



RETAIL

Electricity in the SWIS is retailed by Synergy, a government owned corporation. With approximately 900,000 customers, Synergy is the largest energy retailer in the State. Synergy's main roles include:

- Energy trading (purchasing)
- Marketing
- Sales and customer services
- Billing and payment processing
- Selling accredited renewable energy, carbon neutral electricity, and energy management services

Please refer to Synergy for retail rates (www.synergy.net.au/at_home/prices.xhtml). Customers outside the SWIS are supplied by Horizon Power. There are two categories of electricity consumers in WA being non-contestable and contestable:

Consumers	
Non-contestable (no choice of retailer)	• Customers within the SWIS consuming less than or equal to 50 MW hours of electricity a year • Supplied by Synergy and pay electricity prices regulated by the WA Government as determined under electricity by-laws • Residential households and small businesses usually fall within this category
Contestable	• Customers within the SWIS consuming more than 50 MW hours of electricity a year • All customers outside of the SWIS are contestable and can choose their retailer, however Horizon Power is the only retailer in many regional areas • Can negotiate the rates they pay with their chosen retailer • Medium to large businesses usually fall within this category

QUICK TERMS

Distribution Headworks Charge and Subsidy Scheme:
One-off charge for users connecting to the electricity network, or upgrading their connection, at remote or edge of grid locations where tariffs would not recover the cost of providing increased network capacity. Headworks charges do not apply to customers located within 25km of a substation. Amended in 2007, the scheme is now based on charging customers an average cost rather than on a "first user pays all" approach. Despite the cap on remote locations ($2,000/kVA for residential subdivision and $1,000/kVA for commercial), some customers are still facing high charges.

Transmission and supply:
Power transmission is the bulk transfer of electrical energy, from generating power plants to electrical substations. This is distinct from the local wiring between high-voltage substations and customers, which is typically referred to as electric power distribution or supply.

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Local government and stakeholder consultation

APPENDIX 1 OTHER POWER GENERATORS IN WESTERN AUSTRALIA

Other power generators in WA include:

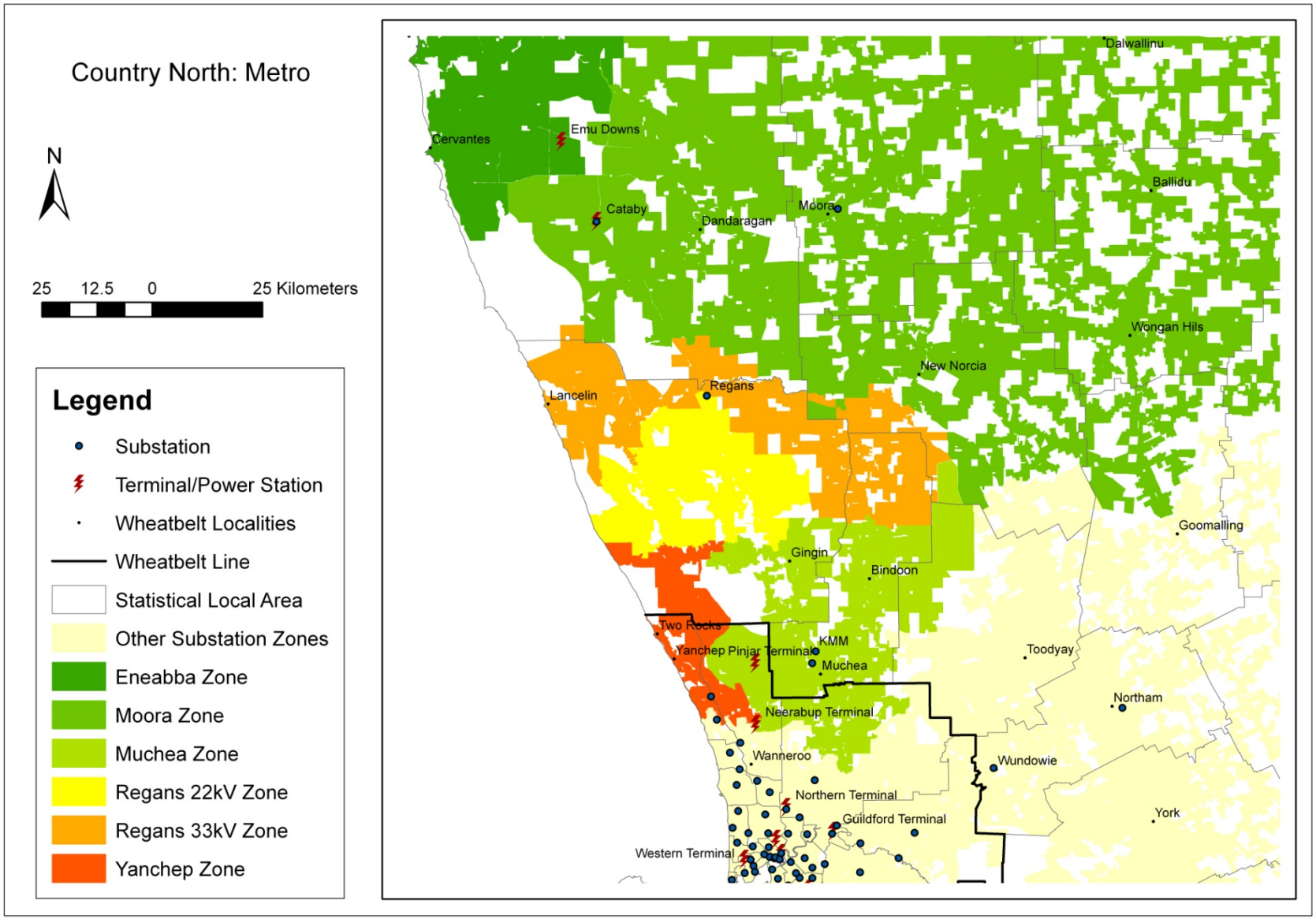
- Alcoa of Australia (Kwinana, Pinjarra, Wagerup)
- Alinta Cogeneration (Pinjarra, Wagerup)
- ATCO Power Australia (Karratha)
- BHP Billiton Worsley Alumina
- Collgar Wind Far (Merredin)
- CSBP (Kwinana)
- EDL NGD (Broom, Derby, Fitzroy Crossing, Halls Creek, Looma, Nameplate)
- EDWF Holdings 1 and 2 (t/a Emu Downs Wind Farm Joint Venture)
- Eneabba Energy
- Goldfields Power
- Griffin Power
- Regional Power Corporation (t/a Horizon Power)
- Mumbida Wind Farm
- NewGen Neerabup Partnership
- NewGen Power Kwinana
- North Western Energy, Pacific Hydro Group & Energis Australia (t/a Ord Hydro)
- Perth Power Partnership
- Rottnest Island Authority
- Electricity Generation Corporation & Origin Energy SWC (t/a South West Cogeneration Joint Venture)
- TEC Desert 1 and 2 (t/a Southern Cross Energy Partnership)
- Tiwest
- Transfield Services Kemerton
- Walkaway Wind Power
- Western Energy
- WR Carpenter

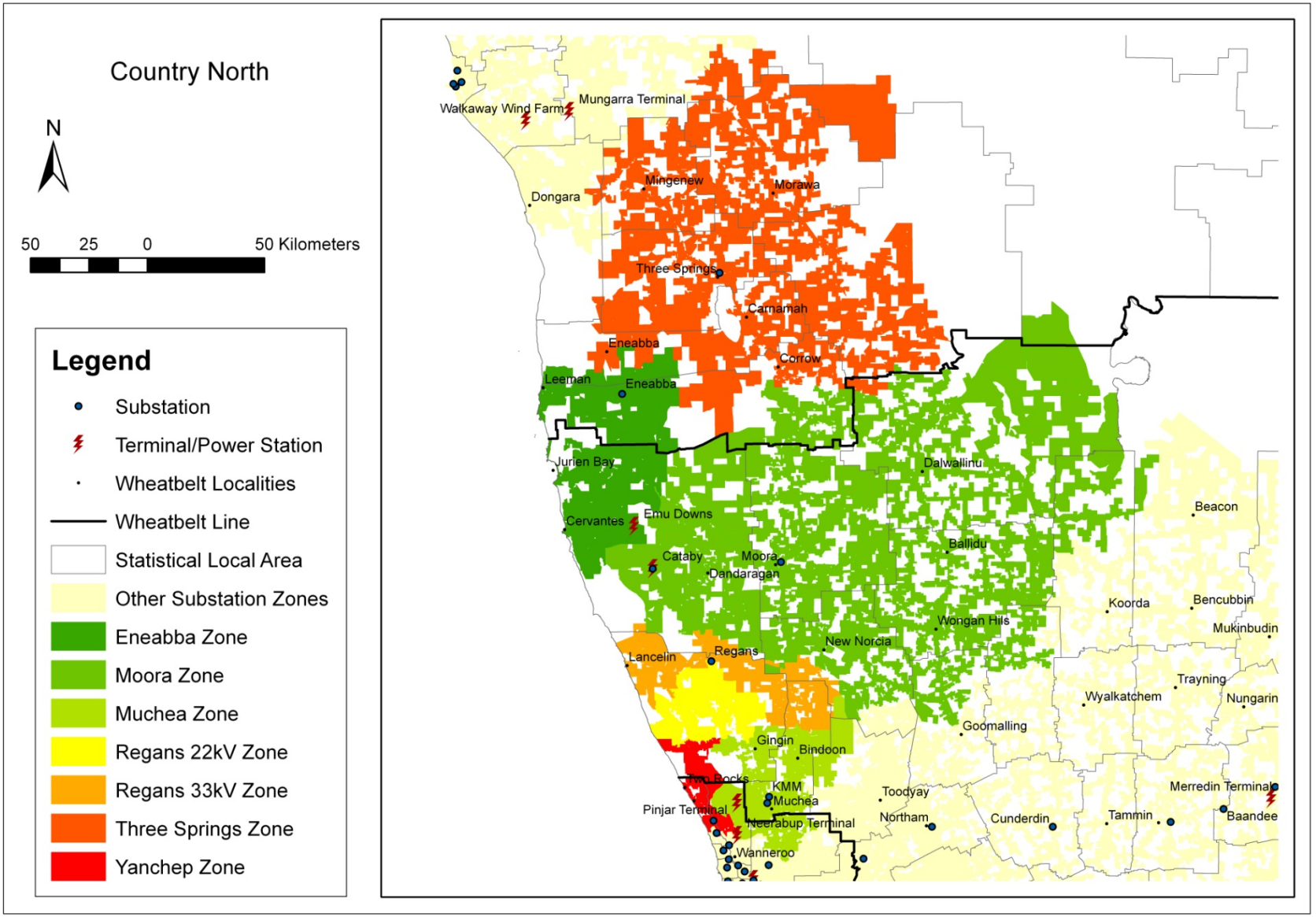
APPENDIX 2 WHEATBELT LOCAL GOVERNMENTS AND THEIR WESTERN POWER REGION

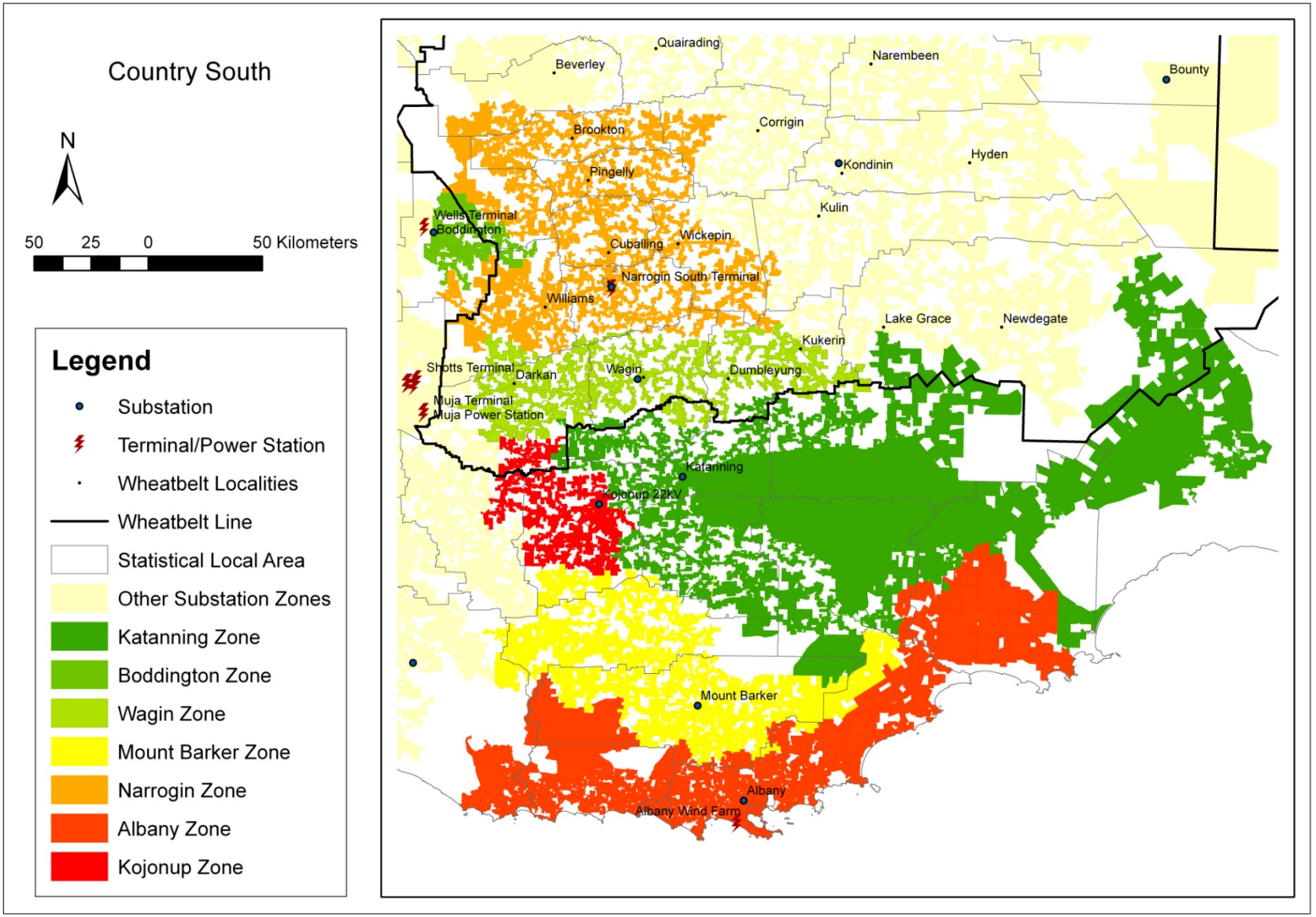
Wheatbelt Local Government	Western Power Planning Region / Sector / Cluster
Avon	
Beverley (S)	Country South, Country East 22kV
Cunderdin (S)	Country East 22kV
Dowerin (S)	Country North 33kV, Country East 22kV
Goomalling (S)	Country East 22kV, Country North 33kV
Koorda (S)	Country North 33kV, Country East 22kV
Northam (S)	Country East 22kV
Quairading (S)	Country East 22kV
Tammin (S)	Country East 22kV
Toodyay (S)	Metro North 22kv (B), Country East 22kV
Wyalkatchem (S)	Country East 22kV
York (S)	Country East 22kV
Central Coast	
Dandaragan (S)	Country North 33kV
Gingin (S)	Metro North 22kV (B)
Central Midlands	
Chittering (S)	Metro North 22kV (B)
Dalwallinu (S)	Country North 33kV
Moora (S)	Country North 33kV
Victoria Plains (S)	Country North 33kV, Metro North 22kV (B)
Wongan-Ballidu (S)	Country North 33kV
Central East	
Bruce Rock (S)	Country East 22kV, Country East 33kV
Kellerberrin (S)	Country East 22kV
Merredin (S)	Country East 22kV
Mount Marshall (S)	Country East 22kV
Mukinbudin (S)	Country East 22kV
Narembeen (S)	Country East 33kV
Nungarin (S)	Country East 22kV, Country East 33kV
Trayning (S)	Country East 22kV

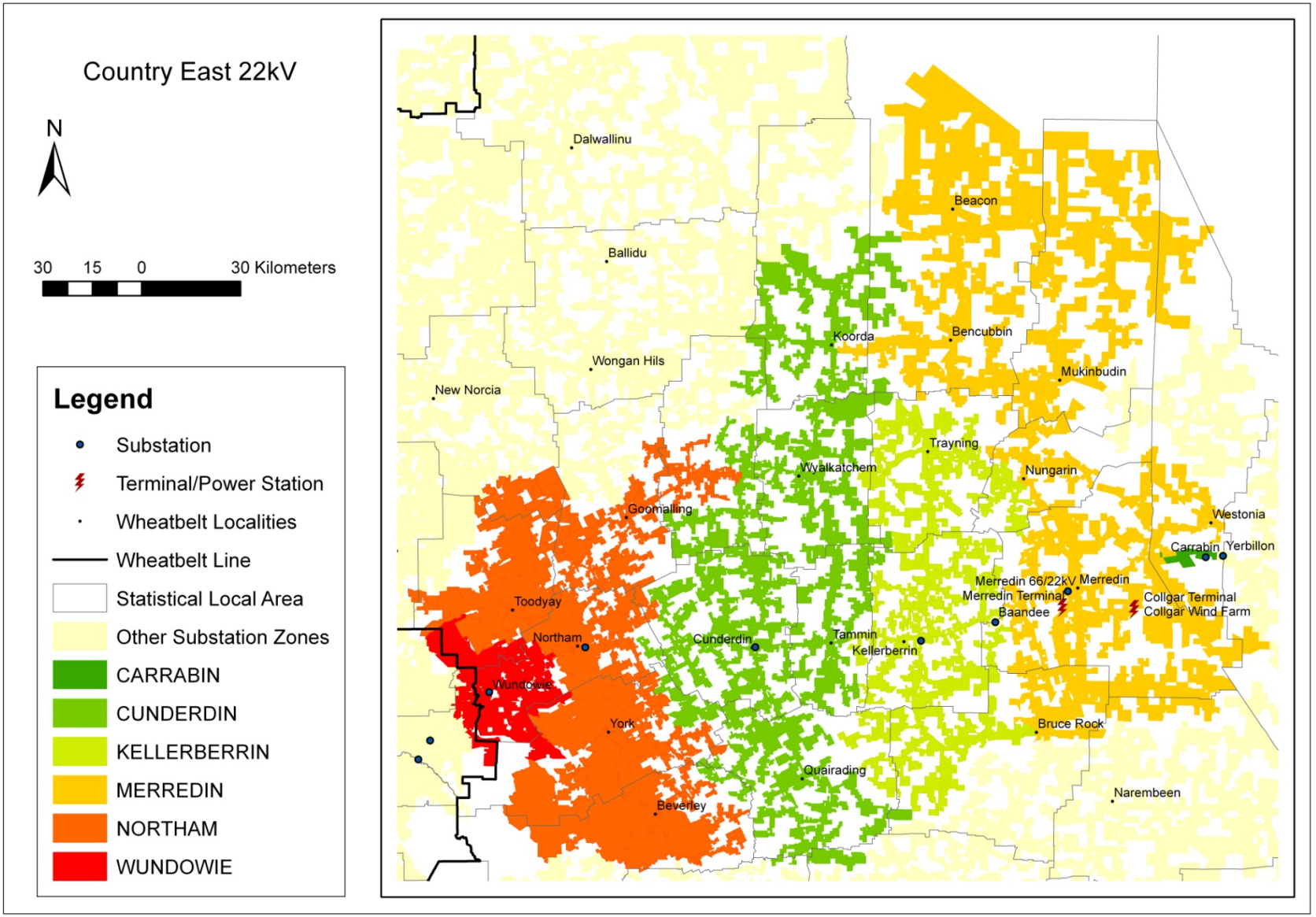
Westonia (S)	Country East 22kV, Country East 33kV
Yilgarn (S)	Country East 33kV
Wheatbelt South	
Brookton (S)	Country South
Corrigin (S)	Country South, Country East 33kV
Cuballing (S)	Country South
Dumbleyung (S)	Country South, Country East 33kV
Kondinin (S)	Country East 33kV
Kulin (S)	Country East 33kV
Lake Grace (S)	Country East 33kV, Country South
Narrogin (S)	Country South
Narrogin (T)	Country South
Pingelly (S)	Country South
Wagin (S)	Country South
Wandering (S)	Country South
West Arthur (S)	Country South
Wickepin (S)	Country South, Country East 33kv
Williams (S)	Country South

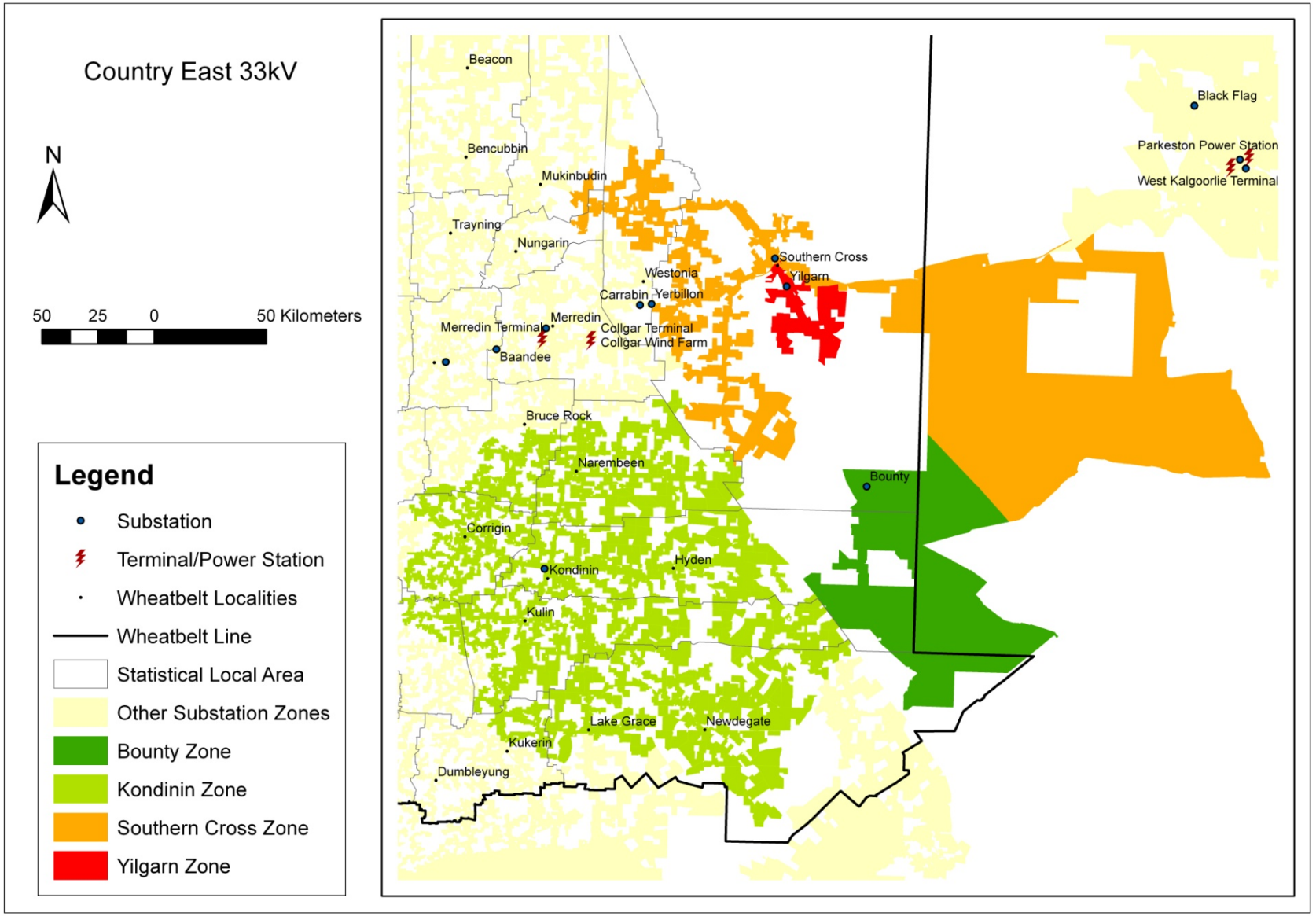
APPENDIX 3 WHEATBELT ZONES




Country North
N
50 25 0 50 Kilometers
Legend
Substation
Terminal/Power Station
Wheatbelt Localities
Wheatbelt Line
Statistical Local Area
Other Substation Zones
Eneabba Zone
Moora Zone
Muchea Zone
Regans 22kV Zone
Regans 33kV Zone
Three Springs Zone
Yanchep Zone
Walkaway Wind Farm
Mungarra Terminal
Dongara
Mingenew
Morawa
Three Springs
Carnamah
Eneabba
Corrow
Leeman
Eneabba
Jurien Bay
Dalwallinu
Cervantes
Emu Downs
Cataby
Moora
Dandaragan
Ballidu
Beacon
Koorda
Bencubbin
Mukinbudin
Wongan Hills
New Norcia
Lancelin
Regans
Trayning
Wyalkatchem
Nungarin
Goomalling
Gingin
Bindoon
Two Rocks
KMM
Muchea
Toodyay
Merredin Terminal
Pinjar Terminal
Neerabup Terminal
Northam
Cunderdin
Tammin
Baandee
Wanneroo


Country South
N
50 25 0 50 Kilometers
Legend
Substation
Terminal/Power Station
Wheatbelt Localities
Wheatbelt Line
Statistical Local Area
Other Substation Zones
Katanning Zone
Boddington Zone
Wagin Zone
Mount Barker Zone
Narrogin Zone
Albany Zone
Kojonup Zone
Quairading
Beverley
Narembeen
Bounty
Brookton
Corrigin
Hyden
Kondinin
Pingelly
Kulin
Wells Terminal
Boddington
Cuballing
Wickepin
Narrogin South Terminal
Williams
Lake Grace
Newdegate
Kukerin
Shotts Terminal
Darkan
Wagin
Dumbleyung
Muja Terminal
Muja Power Station
Katanning
Kojonup 22KV
Mount Barker
Albany
Albany Wind Farm


Country East 22kV
N
30 15 0 30 Kilometers
Legend
Substation
Terminal/Power Station
Wheatbelt Localities
Wheatbelt Line
Statistical Local Area
Other Substation Zones
CARRABIN
CUNDERDIN
KELLERBERRIN
MERREDIN
NORTHAM
WUNDOWIE
Dalwallinu
Ballidu
Wongan Hils
New Norcia
Beacon
Koorda
Bencubbin
Mukinbudin
Trayning
Wyalkatchem
Nungarin
Goomalling
Westonia
Carrabin
Yerbillon
Merredin 66/22kV
Merredin
Merredin Terminal
Baandee
Collgar Terminal
Collgar Wind Farm
Toodyay
Northam
Cunderdin
Tammin
Kellerberrin
Wundowie
York
Bruce Rock
Quairading
Narembeen
Beverley


Country East 33kV
N
50 25 0 50 Kilometers
Legend
Substation
Terminal/Power Station
Wheatbelt Localities
Wheatbelt Line
Statistical Local Area
Other Substation Zones
Bounty Zone
Kondinin Zone
Southern Cross Zone
Yilgarn Zone
Beacon
Bencubbin
Mukinbudin
Trayning
Nungarin
Westonia
Carrabin
Yerbillon
Merredin
Merredin Terminal
Collgar Terminal
Collgar Wind Farm
Baandee
Southern Cross
Yilgarn
Black Flag
Parkeston Power Station
West Kalgoorlie Terminal
Bruce Rock
Narembeen
Bounty
Corrigin
Kondinin
Hyden
Kulin
Lake Grace
Newdegate
Kukerin
Dumbleyung