Environmental Impact Statement

Uungula Wind Farm

May 2020

CWP Renewables Pty Ltd
(02) 4013 4640

P.O. Box 1708 Newcasltle NSW 2300
cwprenewables.com

DOCUMENT TRACKING

Item	Detail
Project Name	Uungula Wind Farm Environmental Impact Statement
Project Number	19ARM – 13867
Project Manager	Robert Cawley 02 8081 2689 92 Taylor Street Armidale, NSW 2350
Prepared by	Rebecca Ben-Haim, Eliza Biggs, Kate Blackwood and Roshan Kalugalage
Reviewed by	Daniel Magdi and Robert Cawley
Approved by	Daniel Magdi
Status	**FINAL**
Version Number	**Final_RevA**
Last saved on	20 May 2020

This report should be cited as 'Eco Logical Australia. (2020). *Uungula Wind Farm Environmental Impact Statement*. Prepared for CWP Renewables Pty Ltd on behalf of Uungula Wind Farm Pty Ltd.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from the following companies: Uungula Wind Farm Pty Ltd and CWP Renewables Pty Ltd.

Submission of an Environmental Impact Statement (EIS)

State Significant Development: Section 4.12 (8).

EIS Prepared by:

Name:	**Robert Cawley**					
Qualifications:	BSc Hons (Ecology)					
Address:	92 Taylor Street, Armidale NSW 2350					
In Respect of:	Eco Logical Australia Pty Ltd					
Development Application:	SSD 6687 Uungula Wind Farm, 14 km east of Wellington NSW					
Applicant Name:	Uungula Wind Farm Pty Ltd					
Applicant address:	PO Box 1708, Newcastle NSW 2300					
Land to be Developed (the Project Site):	**Lot**	**DP**	**Lot**	**DP**	**Lot**	**DP**
	2	DP586633	92	DP750778	3	DP211380
	1	DP406094	123	DP750778	1	DP1239686
	134	DP750778	33	DP750778	120	DP754290
	2	DP1110777	76	DP750778	25	DP750778
	83	DP750779	81	DP750778	24	DP750778
	2	DP233293	21	DP750778	175	DP754290
	2	DP233294	36	DP750753	30	DP750778
	422	DP1206509	26	DP750778	11	DP622801
	1	DP1207626	2	DP1207200	34	DP750753
	78	DP750753	1	DP1207200	122	DP750778
	83	DP750753	82	DP750778	121	DP750778
	40	DP750753	32	DP750778	1	DP1110777
	421	DP1206509	66	DP750778	2	DP211380
	34	DP750778	80	DP750778	69	DP750779
	91	DP750778	20	DP750778	70	DP750779
	124	DP750778	110	DP750778	133	DP750778
	27	DP750778	4	DP211380		
	The Project Site will also be taken to include any Crown land, any Crown waterways or any road reserves, contained within the Project Site.					

Environmental Impact Statement

This Environmental Impact Statement (EIS) assesses the potential environmental impacts associated with the proposed Uungula Wind Farm in accordance with the Secretary's Environmental Assessment Requirements, issued to the proponent on 11 November 2019.

I certify that I have overseen the preparation of the contents of this Statement and to the best of my knowledge:

- It has been prepared in accordance with Schedule 2 of the *Environmental Planning and Assessment Regulation 2000*;
- It contains all available information that is relevant to the environmental assessment of the development to which the statement relates; and
- The information contained in this Statement is neither false nor misleading.

Signature:	
Name:	Robert Cawley
Date:	20 May 2020

Contents

Executive Summary 26

1 Introduction 51

1.1 Context 51

1.2 Purpose of this document 52

1.3 Project Overview 53

1.4 Project Setting 53

1.5 The Proponent 56

1.6 Structure of the EIS 56

2 Alternatives considered 66

2.1 Rationale 66

2.2 Do Nothing Scenario 66

2.3 Alternative Locations 67

2.4 Project Design Principles 67

2.5 Agricultural Use 67

2.6 Site Selection 67

2.7 Design Evolution and Impact Minimisation through Project Adaptation 68

3 Project Justification 83

3.1 Mandate 83

3.2 Current Global Response – The Paris Agreement 85

3.3 Australian Emissions and Response 86

3.4 NSW Government Emissions and Response 90

3.5 Validation 96

4 The Proposal 116

4.1 Overview 116

4.2 Wind Turbine Generators 141

4.3 Energy Storage Facility 147

4.4 Ancillary Infrastructure 148

4.5 Temporary Facilities 161

4.6 Project Phases 166

5 Statutory Framework 176

5.1 Permissibility 177

5.2 Commonwealth Legislation 179

5.3 State Legislation 183

5.4 Local Planning Instruments 197

5.5 Summary of Licences and Approvals Required 198

6 Stakeholder and Community Consultation 199

6.1 Commitment 199

6.2 Consultation Principles: Community Engagement Planning 200

6.3 Stakeholder Identification 202

6.4 Consultation Activities Methods and Timeline 203

6.5 Issues Raised During Stakeholder Consultation 219

6.6 Summary 220

7 Environmental Risk Assessment 221

8 Environmental Impact Assessment 225

8.1 Assessment methodology 225
8.2 Landscape and Visual 227
8.3 Noise and Vibration 274
8.4 Biodiversity 287
8.5 Traffic and Transport 326
8.6 Hazards / Risks 343
8.7 Aboriginal Cultural Heritage 380
8.8 Historic Heritage 393
8.9 Water and Soils 397
8.10 Resource Requirements and Waste 464
8.11 Socio-Economic Factors 475
9 Environmental Management Strategies 485
9.1 Environmental Management Plans 485
9.2 Statement of Commitments 485
9.3 Residual Environmental Risk Assessment 492
10 Conclusion 495
11 References 497

Appendices

Appendix A: Secretary's Environmental Assessment Requirements

Appendix B: EPBC Act Bilateral Agreement Confirmation

Appendix C: Schedule of Land

Appendix D: Centre Point Coordinates for Each WTG

Appendix E: Detailed Project Layout Mapping

Appendix F: SEPP 33 – Preliminary Risk Screening

Appendix G: Framework for Biodiversity Assessment (Eco Logical Australia, 2020)

Appendix H: Assessments of Significance

Appendix I: Collision Risk Model (Environmental Resources Management, 2013)

Appendix J: Aboriginal Cultural Heritage Assessment (NSW Archaeology Pty Ltd, 2018)

Appendix K: Aboriginal Cultural Heritage Assessment Addendum Report (Austral Archaeology, 2019)

Appendix L: Transport Assessment (Samsa Consulting, 2020)

Appendix M: Route Study (Rex J. Andrews, 2020)

Appendix N: Twelve Mile Road Design (iCubed Consulting Pty Ltd, 2020)

Appendix O: Aeronautical Impact Assessment (Landrum and Brown Worldwide (Aust) Pty Ltd, 2020)

Appendix P: Hydrology Assessment (Eco Logical Australia, 2020)

Appendix Q: Community Newsletters and Print Media

Appendix R: Landscape and Visual Impact Assessment (Moir Landscape Architecture, 2020)

Appendix S: Noise and Vibration Impact Assessment (Sonus Pty Ltd, 2020)

Appendix T: Telecommunications and Electromagnetic Interference Study (Middleton Group, 2020)

Appendix U: Bushfire Risk Assessment (Eco Logical Australia, 2020)

Appendix V: Economic Impact Assessment (Ethos Urban, 2020)

List of Figures

Figure 1-1: Project location 54

Figure 1-2: Project layout (indicative) 55

Figure 2-1: March 2011 – Preliminary Environmental Assessment investigation area 72

Figure 2-2: February 2012 – Investigation area is refined 73

Figure 2-3: April 2013 – 249 WTG sites under investigation 74

Figure 2-4: May 2013 – Project design refined to include access tracks, electrical layout and other infrastructure area 75

Figure 2-5: July 2018 – Eastern half of project infrastructure removed 76

Figure 2-6: September 2018 – two WTGs removed; 125 WTGs proposed 77

Figure 2-7: May 2019 78

Figure 2-8: September 2019 layout (109 WTGs) 79

Figure 2-9: February 2020 Final Project Layout (97 WTGs) 80

Figure 3-1: Global carbon dioxide (CO_2) emissions by sector or source (OWID, 2019) 84

Figure 3-2: Interdependent global Sustainable Development Goals (United Nations) 86

Figure 3-3: Average CO_2 emissions per capita measured in tonnes per year in 2016 (OWID, 2019) 87

Figure 3-4: Emissions contribution by sector in Australia (DoEE, 2018) 88

Figure 3-5: Australia's annual greenhouse gas emissions by sector 88

Figure 3-6: NSW total annual emissions to 2030 (DPIE, 2020). Note MtCO2-e = Megatonnes of carbon dioxide equivalent 91

Figure 3-7: NSW emissions by sector in 2017 (DPIE, 2020) 92

Figure 3-8: Location of central-west renewable energy zone 94

Figure 3-9: Total installed WTG capacity between 2013-2017 (MW) 100

Figure 3-10: Calculated LCOE by technology and category for 2020 (GenCost, 2018) 102

Figure 3-11: Estimated carbon footprints; grams of CO_2 per kilowatt of electricity produced (University of Texas Energy Institute, 2017) 103

Figure 3-12: Life Cycle Assessment model of a WTG (Adapted from Martinez *et al.* 2009) 104

Figure 3-13: Evolution of WTGs (IRENA, 2016) 112

Figure 4-1: Potential TransGrid subdivision option one 119

Figure 4-2 Potential TransGrid subdivision option two....120

Figure 4-3 Potential TransGrid subdivision option three....121

Figure 4-4: Indicative lease subdivision map (part one)....127

Figure 4-5: Indicative lease subdivision map (part two)....128

Figure 4-6: Components of a WTG as shown at Sapphire Wind Farm....142

Figure 4-7: Typical gravity (left) and rock anchor (right) foundations....143

Figure 4-8: Example of a WTG tower with the nacelle mounted at Sapphire Wind Farm....144

Figure 4-9: Example of a nacelle for a 3.6 MW WTG at Sapphire Wind Farm....145

Figure 4-10: A single piece blade approximately 62 m long at Sapphire Wind Farm....146

Figure 4-11: Example of a generator transformer located outside of the tower at Boco Rock wind farm....147

Figure 4-12: Saphire Wind Farm O&M compound (foreground) shown in front of the 33 kV substation (aerial view)....150

Figure 4-13: Saphire Wind Farm O&M compound ground level view....150

Figure 4-14: Typical O&M facility layout....151

Figure 4-15: Double-circuit overhead 33 kV transmission line....153

Figure 4-16: Example of double-circuit overhead 330 kV transmission line adjcanet to a new single-pole substation tie-in....153

Figure 4-17: Indicative cable trench design....154

Figure 4-18: Laying underground transmission line within the road network....155

Figure 4-19: Tubular (left) and lattice (right) wind monitoring masts....156

Figure 4-20: Hardstand, tower footing and blade laydown area at Saphire Wind Farm....158

Figure 4-21: Example wind farm construction site offices and compounds....163

Figure 4-22: Example of safety management for on-site staff....173

Figure 5-1: Land use zones within the Project Site....178

Figure 6-1: IAP2 public participation spectrum (as adapted from Lane and Hicks, 2014)....201

Figure 8-1: Results of Community Survey of Landscape Values (Moir Landscape Architecture, 2020)....230

Figure 8-2: Visual baseline and character units map (Moir Landscape Architecture, 2020)....233

Figure 8-3: Residences within and surrounding the Project Site....235

Figure 8-4: Viewpoint assessment locations (Moir Landscape Architecture, 2020) 263

Figure 8-5: Cumulative ZVI assessment – Bodangora and Uungula Wind Farms (Moir Landscape Architecture, 2020) 268

Figure 8-6: Shadow flicker assessment(Moir Landscape Architecture, 2020) 271

Figure 8-7: Predicted noise levels (dB(A)) at a wind speed of 7 m/s (Sonus, 2020) 279

Figure 8-8: Predicted noise levels (dB(A)) at a wind speed of 8 m/s (Sonus, 2020) 279

Figure 8-9: Predicted noise levels (dB(A)) at a wind speed of 9 m/s (Sonus, 2020) 280

Figure 8-10: Predicted noise levels (dB(A)) at a wind speed of 10 m/s (Sonus, 2020) 280

Figure 8-11: Predicted noise levels (dB(A)) at a wind speed of 11 m/s (Sonus, 2020) 281

Figure 8-12: Predicted noise levels (dB(A)) at a wind speed of 12 m/s (Sonus, 2020) 281

Figure 8-13: Biodiversity study area 290

Figure 8-14: Vegetation mapping for the development corridor 297

Figure 8-15: Threatened Ecological Communities 299

Figure 8-16: Threatened flora records 301

Figure 8-17: Threatened fauna records 302

Figure 8-18: Location of the proposed primary Project Site entrypoint on Twelve Mile Road (RJA, 2020) 334

Figure 8-19. Regional road network and proposed construction traffic routes 335

Figure 8-20: Typical electric fields for overhead transmission line (EMFs Info, 2020) 358

Figure 8-21: Typical magnetic fields for overhead transmission line (EMFs Info, 2020) 359

Figure 8-22: Maximum magnetic field from a 33 kV overhead powerline (EMFs Info, 2020) 360

Figure 8-23: Maximum magnetic field from a 132 kV overhead powerline (EMFs Info, 2020) 360

Figure 8-24: Typical magnetic field from a 33 kV underground cables (EMFs Info, 2018) 361

Figure 8-25: Typical magnetic fields for the two main types of 132 kV underground cable (separate cores produce higher fields close to the cable but lower fields away from it) 362

Figure 8-26: Indicative shadow flicker map and wind direction frequency distribution 369

Figure 8-27: Blade throw distance (EDP Renewables, 2005) 378

Figure 8-28: Registered AHIMS sites in relation to the Development Footprint 384

Figure 8-29: Location of historic heritage items identified in the Wellington LEP 395

Figure 8-30: Monthly rainfall and the cumulative rainfall departure (CRD) at Wellington (65034) since 1881 (BoM, 2020a) 400

Figure 8-31: Regional topography around the proposed Project Site 401

Figure 8-32: Relative topography of the Project Site – contour map showing slopes 402

Figure 8-33: Lake Burrendong looking north east towards the Project Site 404

Figure 8-34: Location of the Project Site relative to the drainage sub-catchments 406

Figure 8-35: Surface water resources - Mapped watercourses drainage lines, wetlands, farm dams and Strahler Stream Order within the Project Site 407

Figure 8-36: Guideline VRZ widths, north-west 410

Figure 8-37: Guideline VRZ widths, north-east 411

Figure 8-38: Guideline VRZ widths, south-east 412

Figure 8-39: Guideline VRZ widths, south-west 413

Figure 8-40: Existing conditions 10% AEP flood depths for a region within the Project Site. Depth scale between 0 metres and 2 metres 415

Figure 8-41: Existing conditions 10% AEP velocities for a region of the Project Site. Velocity scale between 0 m/s and 2 m/s 416

Figure 8-42: Mitchell Landscapes 418

Figure 8-43: Map of Regional Surface Geology 420

Figure 8-44: Bores within 5 km of the Project Site, and GDEs identified within and around the Project Site 425

Figure 8-45: Standing water level for two bores (GW273147 and Borehole 273122) and the cumulative rainfall departure (data from BoM station 65034) 426

Figure 8-46: Potential GDEs identified within and around the Project Site 431

Figure 8-47: Soil Landscapes 433

Figure 8-48: Potential acid sulfate soils at the remainder of the Project Site (ASRIS) 447

Figure 8-49: Mining titles context (DPIE, 2020) 449

Figure 8-50: Developed conditions 10% AEP flood depths for the same region of the Project Site as shown in Figure 8-40. Depth scale between 0 metres and 2 metres 454

Figure 8-51: Developed conditions 10% AEP velocities for a region of the Project Site. Velocity scale between 0 and 2 m/s 455

Figure 8-52: Total National Energy Demand consumption (GWh), actual and forecast, 2006-07 to 2038-39 (AEMO, 2019) 479

List of Tables

Table 1-1: Secretary's Environmental Assessment Requirements for the Project 57

Table 1-2: Technical consultants involved in the Project 64

Table 1-3: EIS structure 65

Table 2-1: Project Site and Development Footprint evolution 70

Table 2-2: Residence impact minimisation changes over time – Non-associated residences directly impacted 81

Table 2-3: Neighbour agreements based on impacts 82

Table 4-1: Project components and approximate dimensions 116

Table 4-2: Potential substations lot subdivision and resultant lots 118

Table 4-3: LEP Provisions and subdivision 125

Table 4-4: Road and intersection upgrades required 131

Table 4-5: Anticipated project timeline 135

Table 4-6: Indicative transmission line specifications 152

Table 5-1: Impacts on Matters of National Environmental Significance 180

Table 5-2: Approvals and licences required for the Project 198

Table 5-3: Approvals and licences not required for the Project 198

Table 6-1: Uungula wind farm community engagement objectives 201

Table 6-2: Community engagement guiding principles 202

Table 6-3: Key issues raised by statutory agencies for the Project 204

Table 6-4: Detailed consultation activities timeline and outcomes 212

Table 7-1: Environmental risk assessment rating matrix 221

Table 7-2: Environmental Risk analysis of adverse environmental issues 222

Table 8-1: Residence impact minimisation changes over time – Residences with WTGs visible 227

Table 8-2: Residence impact minimisation changes over time – Non-associated residences requiring visual impact mitigation 227

Table 8-3: Description of Landscape Character Units and Scenic Quality Class Ratings 231

Table 8-4: Summary of ZVI Assessment for each dwelling (Moir Landscape Architecture, 2020) 236

Table 8-5: Viewpoint analysis results (Moir Landscape Architecture, 2020) 247

Table 8-6: Overview of visual impact for each LCU (Moir Landscape Architecture, 2020) 264

Table 8-7: Approved wind farms within the region (Moir Landscape Architecture, 2020) 266

Table 8-8: Non-associated residences impact minimisation changes over time – Noise impact assessment 274

Table 8-9: Background noise monitoring locations and periods (Sonus, 2020) 275

Table 8-10: Wind mast details (Sonus, 2020) 276

Table 8-11: Background noise levels (dB(A)) (Sonus, 2020)..276

Table 8-12: Transformer and battery inverter sound power levels (Sonus, 2020)................................282

Table 8-13: Predicted construction noise levels (Sonus, 2020) 283

Table 8-14: Road traffic noise criteria (Sonus, 2020)...285

Table 8-15: Vibration criteria (Sonus, 2020) 285

Table 8-16: Summary of vegetation zones within Development Footprint 294

Table 8-17: Ecosystem credit species 303

Table 8-18: Species credit species 305

Table 8-19: Additional potential species credit species 309

Table 8-20: Avoidance of Direct Impacts 310

Table 8-21: Avoidance and minimisation of direct impacts through site selection................................311

Table 8-22: Avoidance and Minimisation of Direct Impacts through Planning......................................313

Table 8-23: Project ecosystem offset requirements...314

Table 8-24: Project Species Credit Offset Requirement 316

Table 8-25: EPBC Act listed endangered communities 319

Table 8-26: EPBC Act listed threatened species 320

Table 8-27: Residence impact minimisation changes over time – Transport route passing residences 326

Table 8-28: Road classifications 330

Table 8-29: Current (Estimated) 2019 Estimated Traffic Volumes 331

Table 8-30: Summary of project components and indicative traffic generation 336

Table 8-31: Estimated Project-related construction traffic projections (peak activity or 'conservative' estimates shown in brackets) 338

Table 8-32: Staffing estimates....340

Table 8-33: Summary of NHMRC's Interim Guidelines on limits of exposure to 50/60 Hz electric and magnetic fields....354

Table 8-34: Hazardous materials in the batteries, quantities on site and the classification of each good 370

Table 8-35: Location of AHIMS sites within search area 383

Table 8-36: Local heritage results within the Wellington LGA 394

Table 8-37: Potential impacts on local heritage results (Wellington LEP 2012) 396

Table 8-38: Recommended riparian corridor widths (adapted from NSW NRAR, 2018)....409

Table 8-39: Geological units intersected by the disturbance footprint, and/or the Project Site 421

Table 8-40: Registered bores with standing water level and/or salinity data within 5 km of the Project Site 427

Table 8-41: Terrestrial vegetation species that potentially occur as GDEs in the Project Site, based on regional studies (BoM, 2020). 429

Table 8-42: Soil characteristics and project components in the Project Site 432

Table 8-43: Land and soil capability classes within the Project Site....437

Table 8-44: Erosion and movement soil hazards by soil landscape 441

Table 8-45: Salinity hazard within the Project Site (Wooldridge et al., 2012; OEH, 2016; OEH, 2015) 443

Table 8-46: Compatibility of the Project with the RU1 zone objectives (Wellington LEP 2012) 450

Table 8-47: Key fish habitat and associated sensitivity classification scheme (Fairfull, 2013) 457

Table 8-48: Classification of waterways for fish passage (Fairfull, 2013) 458

Table 8-49: Anticipated construction waste types....468

Table 8-50: Potential waste description 473

Table 8-51: Population projections for Dubbo and Wellington LGA (from Ethos Urban 2019)....480

Table 9-1: Statement of commitments 487

Table 9-2: Residual environmental Risk analysis of adverse environmental issues 492

Abbreviations

Abbreviation	Description
AAAA	Aerial Agricultural Association of Australia
ABS	Australian Bureau of Statistics
ACHA	Aboriginal Cultural Heritage Assessment
ADG Code	Australian Code for the Transport of Dangerous Goods by Road and Rail
AEMO	Australian Electricity Market Operator
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
AHIP	Aboriginal Heritage Impact Permit
AM	Amplitude Modulation
AMA	Australian Medical Association
ANZECC	Australian and New Zealand Environment Conservation Council
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
APZ	Asset Protection Zone
ARENA	Australian Renewable Energy Agency
ARI	Average Recurrence Interval
ARPANSA	Australian Radiation Protection and Nuclear Safety Agency
AsA	Airservices Australia
ASRIS	Australian Soil Resource Information System
ATC	Air Traffic Control
BAM	Biodiversity Assessment Method
BAR	Biodiversity Assessment Report
BBAM	BioBanking Assessment Methodology
BBAMP	Bird and Bat Adaptive Management Plan
BBCC	BioBanking Credit Calculator for Major Projects
BC Act	*Biodiversity Conservation Act 2016*
BCD	Biodiversity Conservation Division within Department of Planning, Industry and Environment
BC Regulation	*Biodiversity Conservation Regulation 2017*
BC Savings and Transitional Regulation	*Biodiversity Conservation (Savings and Transitional) Regulation 2017*
BFSA	Bush Fire Safety Authority
Biosecurity Act	*Biosecurity Act 2015*

Abbreviation	Description
BMP	Biodiversity Management Plan
BoM	Bureau of Meteorology
BOS	Biodiversity Offset Strategy
BSAL	Biophysical Strategic Agricultural Land
BTH	Base to Tip Height
BtoC	Below the Top of Casting
C	Construction
CASA	Civil Aviation Safety Authority
CASR	*Civil Aviation Safety Regulations 1998*
CCC	Community Consultative Committee
CEC	Clean Energy Council
CEEC	Critically Endangered Ecological Community
CEFC	Clean Energy Finance Corporation
CFA	Country Fire Authority
CHL	Commonwealth Heritage List
CHMP	Cultural Heritage Management Plan
CIR	Airport control zones
CLM Act	*Contaminated Land Management Act 1997*
CMA	Catchment Management Authority
COAG	Council of Australian Governments
Conveyancing Act	*Conveyancing Act 1919*
COP2	Conference of the Parties to the Minamata Convention on Mercury
CRD	Cumulative rainfall departure
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CTMP	Construction Traffic Management Plan
CWPR	CWP Renewables Pty Ltd
D	Decommissioning
dB	Decibels
dB(A)	A-weighted decibels
dB(C)	C-weighted decibels
DCP	Development Control Plan
DE	Dwelling Entitlement
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
DGRs	Director-General's Requirements
DIT	Department of Infrastructure and Transport

Abbreviation	Description
DoD	Department of Defence
DotEE	Department of the Environment and Energy
DPE	Department of Planning and Environment
DPIE	Department of Planning, Industry and Environment
DPI	Department of Primary Industries
DTV	Digital television
EA	Environmental Assessment
EEC	Endangered Ecological Community
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EL	Exploration Licence
ELA	Eco Logical Australia Pty Ltd
ELF	Extremely Low Frequency
EMF	Electromagnetic Field
EMI	Electromagnetic interference
EMP	Environmental Management Plan
EMS	Environmental Management Strategy
EPA	Environmental Protection Agency
EP&A Act	*Environmental Planning and Assessment Act 1979*
EP&A Regulation	*Environmental Planning and Assessment Regulation 2000*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPC	Engineering, procurement and construction
EPL	Environment Protection Licence
ERM	Environmental Resources Management Pty Ltd
ERP	Emergency Response Plan
ESD	Ecologically Sustainable Development
ESF	Energy Storage Facility
EU	European Union
EWP	Elevated Work Platform
FBA	Framework for Biodiversity Assessment
FM	Frequency modulated
FM Act	*Fisheries Management Act 1994*
FTE	Full-time Employment
g	gauss
GDE	Groundwater Dependent Ecosystems
GPS	Geographical Positioning System

Abbreviation	Description
GW	Gigawatt
Hazardous Waste Act	*Hazardous Waste (Regulation of Exports and Imports) Act 1989*
Heritage Act	*Heritage Act 1977*
Hz	Hertz
ICN Guideline	Interim Construction Noise Guideline (DECC, 2009)
ICNIRP	International Commission on non-ionizing radiation protection
IEC	International Electrotechnical Commission
IFR	Instrument Flight Rules
INP	*NSW Industrial Noise Policy for Industry 2017*
IPC	Independent Planning Commission
IPCC	Intergovernmental Panel on Climate Change
ISEPP	*State Environmental Planning Policy (Infrastructure) 2007*
ITP	Inspection and Testing Procedure
KFH	Key Fish Habitat
kph	Kilometres per hour
kV	Kilovolt
L	Litre
LCOE	Levelised cost of energy
LCA	Life Cycle Assessment
LCU	Landscape Character Unit
LEP	Local Environment Plan
LFB	Lachlan Fold Belt
LGA	Local Government Area
LLS Act	*Local Land Services Act 2013*
LOS	Line of unobstructed sight
LRET	Large-scale Renewable Energy Target
LRS	Land Registry Services
LSALT	Lowest safe altitude
LVIA	Landscape and Visual Impact Assessment
Mining Act	*Mining Act 1992*
ML	Mega Litre
MNES	Matters of National Environmental Significance
MRET	Mandatory Renewable Energy Target
m/s	Metres per second
MVA	Mega-volt-ampere
MW	Megawatt

Abbreviation	Description
NASAG	National Airports Safeguarding Advisory Group
NDC	Nationally Determined Contribution
NEM	National Electricity Market
NEPP	National Energy Productivity Plan
NHL	National Heritage List
NHMRC	National Health and Medical Research Council
nm	Nautical miles
Noise Assessment Bulletin	NSW Wind Energy: Noise Assessment Bulletin (DPE, 2016c)
NPW Act	*National Parks and Wildlife Act 1974*
NRAR	Natural Resources Access Regulator
NSW	New South Wales
NSWPF	New South Wales Police Force
O	Operation
O&M	Operation and Maintenance
OEH	Office of Environment and Heritage (now the BCD within DPIE)
OEM	Original Equipment Manufacturer
OLS	Obstacle Limitation Surface
OSOM	Oversize and/or Overmass
PANS-OPS	Procedures for Air Navigation Services
PBP 2019	*Planning for Bush Fire Protection 2019*
PCT	Plant Community Type
PCU	Power Conversion Unit
PEA	Preliminary Environmental Assessment
PHA	Preliminary Hazard Analysis
PMP	Point to Multipoint
POEO Act	*Protection of the Environment Operations Act 1997*
POEO General Regulation	*Protection of the Environment Operations (General) Regulation 2009*
POEO Waste Regulation	*Protection of the Environment Operations (Waste) Regulation 2009*
PPE	Personal Protective Equipment
PPRD SEPP	*State Environmental Planning Policy (Primary Production and Rural Development) 2019*
The Proponent	Uungula Wind Farm Pty Ltd
PSR	Primary Surveillance Radar
PtP	Point-to-point
RAAF	Royal Australian Air Force
Radiocommunications Act	*Radiocommunications Act 1992*

Abbreviation	Description
RAP	Registered Aboriginal Parties
RBL	Rating Background Level
RE Act	*Renewable Energy (Electricity) Act 2000*
REAP	Renewable Energy Action Plan
REP	Regional Environmental Plan
RET	Renewable Energy Target
REZ	Renewable Energy Zone
RFS	NSW Rural Fire Service
RMS	Roads and Maritime Services
Roads Act	*Roads Act 1993*
rpm	revolutions per minute
RSR	Route Surveillance Radar
RSWMP	Regional Strategic Weed Management Plans
Rural Fires Act	*Rural Fires Act 1997*
SCA	State Conservation Area
SDG	Sustainable Development Goal
SDS	Safety Data Sheet
SEARs	Secretary Environmental Assessment Requirements
SEPP	State Environmental Planning Policy
SEPP(SRD)	*State Environmental Planning Policy (State and Regional Development) 2011*
SEPP 15	*State Environmental Planning Policy 15 – Rural Landsharing Communities*
SEPP 33	*State Environmental Planning Policy No. 33 – Hazardous and Offensive Development*
SEPP 44	*State Environmental Planning Policy No. 44 (Koala Habitat)*
SEPP 55	*State Environmental Planning Policy No. 55 – Remediation of Land*
SRES	Small-scale Renewable Energy Scheme
SSD	State Significant Development
SSR	Secondary Surveillance Radar
t	tesla
TEC	Threatened Ecological Community
TMP	Traffic Management Plan
TSC Act	*Threatened Species Act 1995*
UWF	Uungula Wind Farm
UHF	Ultra High Frequency
UNFCCC	United Nations Framework Convention on Climate Change
Visual Assessment Bulletin	Wind Energy: Visual Assessment Bulletin (DPE, 2016b)

Abbreviation	Description
VFR	Visual Flight Rules
VHF	Very High Frequency
VMC	Visual Meteorological Conditions
vpd	Vehicles per day
vph	Vehicles per hour
VRZ	Vegetated Riparian Zone
WARR Act	*Waste Avoidance and Resource Recovery Act 2001*
Wellington DCP	Wellington Development Control Plan 2013
Wellington LEP	Wellington Local Environmental Plan 2012
WHL	World Heritage List
WHO	World Health Organisation
WM Act	*Water Management Act 2000*
WMP	Waste Management Plan
WTG	Wind Turbine Generator
ZVI	Zone of Visual Influence

Key Terms

Term	Definition
Ancillary Infrastructure	All wind farm infrastructure with the exception of WTGs and ESF, including but not limited to Collector Substation, Switching Station, permanent offices and site compounds, underground and overhead electricity transmission lines, Permanent Meteorological Masts, communication cables (includes control cables and earthing), water storage tank, hardstands and Internal Roads.
APZ	Asset protection zone.
Clearing	As defined in Part 5A of the *Local Land Services Act 2013*:
Construction	The construction of the Project, including but not limited to the construction of WTG, ESF, Ancillary Infrastructure but excluding Pre-construction Minor Works.
Development Consent	State significant development consent to carry out the Project granted by the consent authority under the *Environmental Planning and Assessment Act 1979*.
Development Corridor	The area generally bound by a buffer of 100 m radius around the Development Footprint as shown in Figure 1-2. For the absence of doubt, the oversail of WTGs may extend beyond this Development Corridor but will be within the Project Site.
Development Footprint	The extent of ground disturbance including earthworks associated with Permanent Infrastructure and Temporary Facilities (other than Temporary Field Laydown Areas) in the Project Site. For the absence of doubt: • The oversail of WTGs may extend beyond the Development Footprint but will be within the Project Site. • Temporary Field Laydown Areas may occur outside the Development Footprint (refer to Temporary Field Laydown Areas definition).
Energy Storage Facility (ESF)	Compound for storing and discharging energy comprised of buildings, shipping containers and other infrastructure required to connect the ESF, WTGs, and Substations via underground and/or overhead cables.
External Road Upgrades	Upgrade of roads external to the Project Site and associated vegetation clearing and/or pruning, required to transport Project-related components and materials to and from the Project Site.
Ground Disturbance	Activities that cut into the existing ground surface. For the absence of doubt this does not include activities that occur on the ground surface including but not limited to driving vehicles on the ground, parking vehicles, placing infrastructure or materials such as stockpiles on the ground.

Term	Definition
Heavy Vehicle	Rigid vehicle over 8 tonnes GVM or has more than 2 axles. An articulated vehicle with three or more axles, or a vehicle configuration which does not require a permit from the National Heavy Vehicle Regulator.
Internal Roads	The roads established within the Project Site for the purposes of constructing, operating, maintaining and decommissioning the Project (sometimes referred to as 'tracks' or 'access tracks') and includes all waterway crossings).
Light Vehicle	Car or rigid truck to 8T GVM or bus to 12 seats.
Meteorological Masts	Temporary and Permanent masts up to hub height of the WTGs and of a guyed, narrow lattice or tubular steel design and concrete footings of approximately 1 m^2 for each of the mast and guy wires. Guy wires may extend beyond 100 m from the base of the mast. The final number and location of the masts will be determined post-Development Consent, post-WTG selection and detailed design. The masts and the guy wires that secure them may need to be located outside of the Development Corridor, however they will remain within the Project Site.
Operation	Occurs when the entire wind farm is commissioned and formally handed over to the Project's owners. It does not include commissioning trials of equipment or use of Temporary Facilities.
OSOM	Over Size, Over Mass vehicle; vehicle configuration which requires a permit from the National Heavy Vehicle Regulator.
Permanent Infrastructure	Infrastructure that will remain on the Project site during for the operational phase of the Project, including WTGs, ESF and Ancillary Infrastructure.
Pre-construction Minor Works	Includes the following activities which are necessary to undertake detailed design and prepare for the commencement of construction: • Surveys. • Building/road dilapidation surveys. • Investigative drilling, excavation or salvage. • Minor clearing or translocation of native vegetation. • Establishing temporary site office and compounds. • Installation of environmental impact mitigation measures, fencing, enabling works, Meteorological Masts. • Flora and fauna investigations and pre-clearing surveys, inspections, specific habitat feature removal, relocation. • Establishing Project Site access points, minor access roads and minor adjustments to services/utilities, signage etc. including associated vegetation removal and heritage artefact salvage. • Upgrading Twelve Mile Road and Project Site entries.

Term	Definition
	• Intersection and road upgrades on the public road network.
Project	The Uungula Wind Farm described in Section 3 of this EIS.
Project Site	The land required for the Project as shown in **Appendix C** and shown in Figure 1-1, and includes Crown land, Crown waterways, Crown roads and Council roads.
Pruning	The selective removal of certain parts of a tree or shrub such as branches, limbs or foliage.
Substations	Infrastructure required to collect the internal electrical reticulation to increase the voltage for transmission to connect to the grid. Typically includes include step-up transformers, an array of cable marshalling, busbars, switchgear and protection, various voltage and current transformers, operation and facilities building with parking, communication facilities and tower, diesel generator, lighting, a buried earth grid, lightning masts, power conditioning equipment, a reactive power control system, and network support equipment as required and agreed with TransGrid (or other transmission network system operator).
Temporary Field Laydown Areas	Areas that components may be placed on the ground in preparation for moving or relocating around the Project Site. These areas will mostly not require earthworks and therefore are outside of, and not included in the Development Footprint. They will occur within the Project Site.
Temporary Facilities	Facilities used for the construction, repowering and/or decommissioning of the Project, including but not limited to temporary site offices, amenities, and compounds, rock crushing facilities, concrete or asphalt batching plants, stockpiles and materials storage compounds, Temporary Field Laydown Areas, minor 'work front' construction access roads and temporary Meteorological Masts.
WTG	Wind Turbine Generator; turbines used for the generation of electricity by wind, including the tower, blades and associated components.

Executive Summary

Introduction

This Environmental Impact Statement (EIS) has been prepared for CWP Renewables Pty Ltd (CWPR) on behalf of Uungula Wind Farm Pty Ltd (the 'Proponent') to support a Development Application to install, operate and maintain up to 97 Wind Turbine Generators (WTGs), an Energy Storage Facility (ESF), associated Ancillary Infrastructure and Temporary Facilities in the Central-West region of New South Wales (NSW), 14 km east of Wellington.

CWP Renewables (CWPR) is an industry leading developer, builder and operator of large-scale renewable energy projects. CWPR's track record includes the successful construction and operation of seven large-scale renewable energy projects totalling 1,524 megawatts (MW) of generation across Europe (763 MW) and Australia (761 MW).

CWPR's organisational capacity to deliver the Project builds upon this proven track record and close understanding of the market environment having brought to financial close three greenfield renewable energy projects totalling 645 MW since December 2016.

The Proposal

Fully constructed, the Uungula Wind Farm (the 'Project') is expected to have an electricity generation capacity of approximately 400 MW at the point of connection, producing enough clean energy to power the equivalent of 170,000 average NSW households each year.

The inclusion of an Energy Storage Facility (ESF) will allow for the Project to store and dispatch scheduled and reliable energy to and from the Project or the National Electricity Market (NEM).

The electricity generated and dispatched by the Project would result in significant carbon savings due to the electricity displaced from the current NSW generation supply, which is heavily reliant on coal powered generation. Based on current NSW emission figures of 0.87 kg of CO_2-equivilent per kWh, up to 1.1 million tonnes of CO_2 would be displaced by the Project annually.

The Project would include, but not necessarily be limited to, the following elements:

- **Up to 97 WTGs:** WTGs used for the generation of electricity by wind, including the tower, blades and associated components. WTGs will have a maximum height of 250 m;

- **ESF:** Compound for storing and discharging energy which is comprised of buildings, shipping containers and other infrastructure required to store or dispatch energy and to connect the ESF, WTGs, and Substations via underground and/or overhead cables;
- Ancillary infrastructure, including:
    - **Hardstands:** Hardstands are required adjacent to each WTG location for the assembly, erection, maintenance, repowering and/or decommissioning of a WTG;
    - **Up to 90 km of Internal Roads and Drainage:** The roads established within the Project Site for the purposes of constructing, operating, maintaining and decommissioning the Project;
    - **Substations:** Required to collect the internal electrical reticulation to increase the voltage for transmission to connect to the grid
    - **Up to 2 x Operations and Maintenance (O&M) Compounds:** Established for the day to day operation of the Project;
    - Up to 12 km of external overhead transmission lines;
    - Up to 15 km of internal overhead transmission lines;
    - Up to 90 km of underground transmission lines;
    - **Approximately 6 x Permanent Meteorological Masts:** Permanent masts up to hub height of the WTGs and of a guyed, narrow lattice or tubular steel design and concrete footings of approximately 1 m^2 for each of the mast and guy wires;
    - Utility services; and
    - Signage.
- Temporary Facilities, including:
    - Site offices and compounds;
    - Rock crushing and concrete or asphalt batching plants;
    - Stockpiles and materials storage compounds;
    - Laydown areas;
    - Minor ‘work front’ construction access roads; and
    - Approximately 12 x temporary Meteorological Masts.

The final scale and capacity of the Project would be optimised within the Project Site during post-consent studies based on a combination of the most suitable technology at the time of procurement, along with detailed grid connection studies.

It is anticipated that the Project would take approximately 24 – 30 months to construct and would be operational over an initial term for approximately 30 years. It is anticipated that the Project could extend for a further term depending on market and commercial circumstances. Decommissioning and restoration would occur at the end of the operational life of the Project.

Project Justification

The Project has been designed to align strongly with the principles of ESD, particularly inter-generational equity. The social, economic and environmental benefits of developing renewable energy projects, and transitioning to a low carbon future are unequivocal, providing potential benefits to entire communities and helping to maintain quality of life. Indeed, increased adoption of renewable energy sources will assist Australia to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and carbon emissions associated with climate change.

There is a growing realisation that the environmental impacts associated with the generation of energy through the use of fossil fuels requires serious and urgent mitigation. This realisation has incorporated into international, national and state-wide commitments to support greenhouse gas emission reductions and sustainable energy developments.

Australia is a signatory to international agreements, conventions and protocols regarding climate change and the reduction of greenhouse gas emissions, including the 2015 Paris Agreement to reduce CO_2 emissions to 26% - 28% below 2005 levels by 2030 (DoEE, 2017). In addition, NSW has committed to an aspirational target of achieving net-zero emissions by 2050. The electricity generated and dispatched by the Project would result in significant carbon savings due to the electricity displaced from the current NSW generation supply, which is heavily reliant on coal powered generation. Based on current NSW emission figures of 0.87 kg of CO_2-equivilent per kWh, up to 1.1 million tonnes of CO_2 would be displaced by the Project annually.

Electricity generation is the largest source of Australia's emissions, accounting for 33.7% of emissions in the year of September 2018 (DEE, 2018). Australia's Renewable Energy Target (RET) is currently aiming to acquire 45,000 GWh of Australia's electricity from renewable sources by 2020. To meet the RET, the Clean Energy Regulator estimates that approximately 6,400 MW of new large-scale renewable energy capacity is required to be built and connected to the NEM by 2020. Wind power is currently the cheapest form of new-build electricity available in the market and is expected to form the bulk of this new generation capacity. The Project will therefore play an important role in contributing to both the increasing local and global need for such renewable projects to tackle the issues of global warming and climate change; contributing approximately 6.3 % (dependent on the installed capacity) additional renewable energy generation to meet the legislated Australian target.

At the national level, the Australian Energy Market Operator (AEMO) have identified several highly valued Renewable Energy Zones (REZs) within the NEM with good connection access to existing transmission infrastructure. The Project is located within REZ N3 (the Central-West REZ) which is identified as an immediate AEMO priority zone.

At the state level, the incumbent government has aligned its Electricity Strategy (Nov 2019) with AEMO's recommendation established the Central-West REZ as the pilot REZ for development, targeting the connection of 3,000 MW of new renewable energy capacity to be connected to the network.

Throughout the development phase of the Project, significant impact minimisation steps to reduce impacts have been made. The Proponent has been proactive in responding to community feedback and the Project design has changed extensively in response to community concerns, environmental investigations, market dynamics and WTG technological advancement.

Residual risks following the application of mitigation strategies identified in this EIS are shown to be generally low or medium and can be reasonably managed.

Statutory Position

The Project is an electricity generating development that will have a capital investment value of more than $30 million and is therefore classified as State Significant Development (SSD) under Clause 20 of Schedule 1 of the *State Environmental Planning Policy (State and Regional Development) 2011*.

The Proposed Development is sited on land zoned as RU1 Primary Production under the *Wellington Local Environmental Plan 2012* (Wellington LEP). Wind energy systems are prohibited in the RU1 Zone. However, pursuant to clause 34(1b) of the *State Environmental Planning Policy (Infrastructure) 2007*, development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial or special use zone. Therefore, the Project is permissible with consent.

The NSW Minister for Planning is the consent authority for SSD applications. This EIS has been prepared in accordance with the requirements of Division 4.7 of the *Environmental Planning & Assessment Act 1979* (EP&A Act), Schedule 2 of the *Environmental Planning and Assessment*

Regulation 2000 and the Secretary's Environmental Assessment Requirements, dated 11th November 2019.

Consultation

CWPR has carried out extensive consultation with the local community, stakeholders from the wider area and relevant Government Agencies in order to understand and respond to community concerns during the design and assessment process leading to this Development Application.

Activities that have taken place are listed below:

- Identification and consultation (ongoing) with host landholders and neighbouring residents and the wider community;
- Various community-based activities, including a regular Community Consultative Committee meeting, maintenance of the project website with minutes of such meetings and community newsletter distributions;
- Consultation with the Aboriginal community through the preparation of the Aboriginal Cultural Heritage Assessment (ACHA);
- TransGrid consultation;
- Local Government consultation;
- State Government consultation;
- Website information (www.uungulawindfarm.com.au; www.cwprenewables.com); and
- Media coverage at the local, regional and national scale.

Consultation for the Project began in 2008, and over the life span of the development of the proposal, the Project has undergone design reviews to incorporate the outcomes of the consultation process. Since receiving updated SEARs in 2016, the Project underwent a significant design review. The Project was significantly revised in July 2018 to remove all proposed WTGs and other infrastructure from east of the Cudgegong River (i.e. the Yarrabin and Piambong areas). This decision was based on a detailed review of the grid network and extensive consultation with landowners and neighbours to the proposed Project. Consultation has contributed to a design that satisfies the avoid-minimise-mitigate hierarchy.

Furthermore, the Proponent received feedback on variety of issues in relation to the Project, of which many have prompted Project design changes. Such issues included:

- Biodiversity loss;
- Dust;

- Erosion;
- Firefighting;
- Landscape and visual amenity;
- Noise;
- Road modifications, traffic and transport management; and
- Water use.

Consultation activities remain ongoing at the time of preparing this EIS.

Environmental Assessment

In designing the Project, the following hierarchy has been adopted in order to manage potential environmental impacts:

1. Avoid – in the first instance, all efforts will be made to avoid potential environmental impacts;
2. Minimise – where potential impacts cannot be avoided, design principles shall seek to minimise environmental impacts, as far as feasibly possible;
3. Mitigate – mitigation strategies will be implemented to manage the extent and severity of remaining environmental impacts; and
4. Offset – environmental offsets shall be used only as applicable, following all efforts to first avoid, minimise and mitigate environmental impacts.

This Environmental Impact Statement (EIS) has been undertaken to assess potential environmental impacts for a range of issues identified through the consultation process and site investigations. All potential environmental constraints associated with the Project Site have been identified and are responded to within this EIS.

Large-scale infrastructure projects often play out over a long period of time and involve significant planning and assessment activities in the background prior to seeking statutory approval. This is the case with this Project, with initial work and investigations commencing in 2009.

The Project as presented in this EIS represents all of the outcomes of an ongoing process of assessment, analysis and consultation. In particular, throughout the evolution of the Proposal, the Project has sought to identify environmental and social constraints, and to respond to these in accordance with the Avoid-Minimise-Mitigate hierarchy that underpins the environmental assessment process. Where residual impacts remain, offsets are applied as applicable.

In particular, the Proponent has sought to identify and respond to community expectations identified through ongoing consultation and has proactively modified and updated the proposal to achieve beneficial outcomes. Accordingly, the Project as presented in this EIS represents the optimised concept design and benefits from broad community awareness and measured support.

Landscape and Visual

The Project is located in a gently undulating landscape dominated by agricultural grazing activities. Through ongoing consultation during the Project's evolution, the project has sought to minimise impacts to nearby receptors and to identify alternative design approaches to achieve improved outcomes, such as reducing the number and relocating WTGs, while maintaining power generation capacity through larger WTGs.

A Landscape and Visual Impact Assessment was undertaken by Moir Landscape Architecture (2020) in accordance with the *Wind Energy: Visual Assessment Bulletin* (DPE, 2016b), this included a Community Survey of Landscape Values which was undertaken to assist in identifying key landscape values. Of the 24 responses, the most highly valued aspect of the local community was farming (32%) and views (26%). Local rivers and creeks, farmland and rolling hills, rocky hills and outcrops were considered to hold the most scenic value. There was general support for renewable energy investment in the region however, 77% of those surveyed believed there would be a negative impact on the character of the local landscape.

A Zone of Visual Influence (ZVI) assessment was undertaken to identify the areas of surrounding land from which the Project may be partially or completely visible. As a worst-case scenario, the ZVI assessment was based on the blade tip of each WTG (being 250 m). Out of the 96 assessed dwellings, it was concluded that there are seven dwellings within 3.35 km of the nearest WTG where mitigation measures are recommended. There are a further four dwellings within 3.35 – 5.0 km of the nearest WTG where screening may be required.

A viewpoint analysis was undertaken to determine the likely impact the Project would have on the existing landscape character and visual amenity. A total of 46 viewpoints within three Visual Influence Zones were assessed.

The assessment identified three viewpoints located within the Visual Influence Zone One, which may be visually impacted by the Project, being VP32, VP33 and VP35. Mitigations would need to be considered for all residences associated with these viewpoints and are recommended per dwelling in Section 8.2.

The viewpoint analysis concluded that the Project was likely to dominate existing views from six viewpoints within the Visual Influence Zone Two, being VP28, VP29, VP31, VP34 and VP46. Mitigations would need to be considered for some residences associated with these viewpoints and are recommended per dwelling in Section 8.2.

Thirteen viewpoints were classified within the Visual Influence Zone Three. No visual performance objective applies for landscape scenic integrity or key feature disruption.

Due to both the topography of the landscape and the distance between the Project and the other proposed wind farms, there is limited opportunity to view more than one proposed wind farm from a single viewpoint.

It was concluded that the impacts of the Project on the visual amenity of the landscape can be satisfactorily accommodated, provided the recommended mitigation measures, such as landscape and visual screen planting, are implemented.

Noise and Vibration

The Project is located in a predominantly agricultural landscape, characterised by low background noise levels. Concerns regarding noise generation have been raised through the community consultation process and are addressed throughout the evolution of the concept design for the Project. Potential noise and vibration impacts have been minimised throughout the concept design evolution process, with the objective to minimise impacts at nearby residences.

A Noise and Vibration Impact Assessment was undertaken by Sonus Pty Ltd (2020) in accordance with the *Wind Energy: Noise Assessment Bulletin* (DPE, 2016c).

The sound power level data of three WTG models was analysed, which included the *Vestas V162-5.6MW, Siemens Gamesa 170 6.0MW* and *General Electric GE5.5-158.* As a worst-case scenario, the model with the highest sound power level, being the *Vestas V162-5.6MW*, was used for the assessment.

Noise predictions from the Project were determined using the CONCAWE noise propagation model and SoundPLAN noise modelling software, which considers the following:

- sound power levels and locations of noise sources;
- separation distances between noise sources and receivers;
- topography of the area;
- influence of the absorption provided by the ground;
- air absorption; and
- meteorological conditions.

The Project will comply with the noise criteria at all but one non-associated dwelling, ILG006 (for a wind speed of 7 m/s and above). It is understood that ILG006 is a derelict house on land owned by Water NSW and is therefore not considered to be a relevant sensitive receptor. Based on these circumstances, the operation of the Project will achieve the project noise criteria at all relevant receivers.

The noise assessment for Ancillary Infrastructure was undertaken in accordance with the NSW *Noise Policy for Industry* (EPA, 2017). In accordance with the Noise Policy for Industry, a Rating Background Level (RBL) of 30 dB(A) was applied for all dwellings for this assessment. The main sources of noise from the proposed Ancillary Infrastructure will be the Substations (in particular the two 300 Mega-Volt-Ampere (MVA) rated transformers) and the ESF (in particular the battery inverters with a combined capacity of up to 150 MW). Given the final locations are not yet known and to provide flexibility in the detailed design, predictions have been made based on all locations being used, although this is unlikely to occur. The noise level is predicted to be no more than 24 dB(A) at any residence, from the combined operation of all three substations and two energy storage facilities. Based on these predictions, the criterion of 30 dB(A) will be achieved for residences near all locations and the operation of the Ancillary Infrastructure will not adversely impact the amenity of residences within the locality of the Substation and ESF.

Potential construction noise was assessed in accordance with the *Interim Construction Noise Guideline* (ICN Guideline) (DECC, 2009). The predicted noise levels are based on a separation distance between the closest proposed WTG and non-associated dwelling, which is approximately 1,000 m (ILG006, a derelict house). In accordance with the ICN Guidelines, the noise level criterion is 40 dB(A), which is 10 dB(A) above the RBL. construction noise will exceed 40 dB(A) at 1,000 m. However, the predicted noise levels are significantly less than the 75 dB(A) upper limit outlined within the ICN Guideline. Dwellings to be located between 1,000 m and 2,400 m may be defined as ‘noise affected’ in accordance with the ICN Guideline, which require the proponent to apply all feasible and reasonable work practices, and to inform the residents of the proposed construction work.

Traffic noise was assessed in accordance with the NSW *Road Noise Policy* (DECCW, 2011), which provides both day and night assessment criteria based on road category and relative increase to the existing traffic noise levels. The Project has the potential to impact on road traffic noise during construction through the increase of both passenger vehicle and heavy vehicle movements to and from the Project Site. Such vehicles will include semi-trailers, low loaders, haulage trucks, mobile cranes, water tankers, four-wheel-drive vehicles and passenger vehicles. It is predicted that at 10 m from the roadside, the daytime criterion can be achieved for ten passenger vehicle movements and three heavy vehicle movements per hour. The number of vehicle movements can double for every doubling of distance from the roadside and continue to achieve the 55 dB(A) criterion. That is, 20 passenger vehicles and six heavy vehicle movements could be accommodated per hour at a dwelling that is 20 m from the roadside.

The vibration assessment was undertaken in accordance with the *Assessing Vibration: A Technical Guideline* (DECC, 2006). The main sources of vibration from the Project are likely to be the rock trenching equipment, rock breaking/blasting and roller operation during the road and hard stand construction. To achieve the required construction vibration criteria, construction activities are required to be at least 20 m from the nearest residences. At 100 m, vibration for the above listed activities is unlikely to be detectable to humans. The nearest residences are more than 100 m away from the construction activities therefore, the criterion is expected to be easily achieved.

The noise and vibration impacts associated with the Project can be satisfactorily accommodated, provided the recommended mitigation measures are implemented.

Biodiversity

A Biodiversity Assessment Report (BAR) and Biodiversity Offset Strategy (BOS) was developed in accordance with the NSW Framework for Biodiversity Assessment (FBA) in response to the Project SEARs.

The BAR identified 5 Biometric Vegetation Types (BVTs):

- CW112 - Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion;
- CW177 - Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion;
- CW202 - Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland of hills of the South Western Slopes;
- CW211 - White Box - Rough-barked Apple alluvial woodland on the NSW western slopes; and
- CW212 - White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes.

One Threatened Ecological Community (TEC) was identified within the study area, being White Box Yellow Box Blakely's Red Gum Woodland, listed as endangered under the *Biodiversity Conservation Act 2016* (BC) and critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The Development Footprint has been subject to considerable revision and reduction since it was first conceptualised and is currently approximately one third the size of the original Project design. The area of native vegetation to be impacted has reduced from 1,880 ha to 639 ha under the current Development Footprint. Consideration of biodiversity constraints has, and will continue, to provide significant input into the final Development Footprint.

The Project will unavoidably impact approximately 639 ha of native vegetation within the Development Corridor based on the current Development Footprint (note that the Development Footprint used in this BAR includes the area of clearing required for the External Road Upgrades along Twelve Mile Road between Goolma Road in the west and the Primary Project Site Entry). The Development Footprint described in this assessment is indicative only and subject to a detailed design process. It is expected that the offset requirement will be reduced once the final Development Footprint is determined. The Proponent requests flexibility within pending consent conditions that the timing of determining final offset requirements and offsets is cognisant of the detailed design process. This is essential to avoid unnecessary liabilities, and therefore costs, onto the Project which would ultimately pass through to electricity consumers.

Based on the current Development Footprint, the BAR concluded that the Project will be required to retire:

- 26,988 ecosystem credits;
- 3,632 species credits for Koala; and
- 3,073 species credits for Squirrel Glider

Further assessment may be required to exclude the following species:

- Brush-tailed Rock-wallaby;
- Eastern Pygmy-possum; and
- Regent Honeyeater.

Although the above species were not recorded, suitable habitat is present within the current Development Footprint. Further assessment for these species will be undertaken, or expert report prepared, once the Development Footprint has been finalised and areas of suitable habitat to be affected by the Project can be definitively identified.

No threatened flora species were recorded within the Study Area however, 5 threatened flora candidate species were identified as having the potential to occur in the Development Footprint based on the associated BVTs, presence of suitable habitat and nearby previous records:

- *Acacia ausfeldii* (Ausfeld's wattle);
- *Dichanthium setosum* (Bluegrass);
- *Swainsona sericea* (Silky Swainson-pea);
- *Swainsona recta* (Small Purple-pea); and
- *Zieria obcordata.*

Proponent will commit to undertaking pre-clearing surveys in areas of suitable habitat prior to vegetation clearing and micro-siting of infrastructure will be employed to avoid any impact to previously unrecorded threatened flora species.

For the purposes of assessment under the EPBC Act, the Commonwealth will accredit the FBA. Written confirmation was received from the (former) Department of Environment and Energy in January 2017 that the impacts of the Project are to be assessed under the accredited NSW process. Assessment of EPBC Act protected species and communities was undertaken in accordance with the *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* (Commonwealth of Australia 2013). It was concluded that no significant impacts will occur to EPBC listed species or communities.

The Project is not expected to significantly impact on any aquatic ecology due to the absence of permanent streams and waterways within the Development Corridor. Nonetheless, threatened aquatic species and ecological communities with the potential to occur in the area were identified and the significance of any impacts from the Project have been assessed.

The assessment of significance of any impacts to aquatic ecology was undertaken in accordance with Section 220ZZ of the *Fisheries Management Act 1994.* The assessment concluded that the Project will not result in significant impacts to any aquatic ecology.

Traffic and Transport

Traffic and transport impacts may create a number of direct and indirect adverse effects and concerns regarding traffic impacts have been identified throughout the community and stakeholder consultation process. The Project has considered potential impacts from port to the Project Site, with the intention of minimising impacts to urban and business areas, residences and other road users. A particular focus has been reducing impacts to sensitive receptors (residences) in the vicinity of the Project Site.

The transport and traffic implications arising from the Project have been assessed and documented in the Traffic Assessment (Samsa Consulting Pty Ltd, 2020), the Route Study (RJA, 2020), and the plans for Twelve Mile Road (iCubed, 2020).

The construction phase of the Project involves haulage of components for up to 97 WTGs, as well as associated materials and equipment over a period of approximately 30 months. Construction related haulage activities includes the use of Oversize and/or Overmass (OSOM) vehicles that require special consideration and separate approval to traverse public roads. During construction Project traffic generation is anticipated to be approximately 10 OSOM vehicle movements, 90 heavy vehicle movements and 240 Light Vehicle movements (which is five OSOM vehicles, 45 heavy vehicles (HVs) and 120 light vehicles (LVs) per day that each drive in and then out). At peak construction it is estimated that the daily Project traffic generation will increase to 96 HV movements and 400 LV movements (no increase is anticipated for OSOM vehicle movements) (which is 48 HVs and 200 LVs per day that each drive in and then out).

The higher estimates numbers are the anticipated vehicle movements during the peaks of site construction activity and will not likely occur on each day of the entire construction period. Important to note is that the number of light vehicles is a function of personnel per car, thus where car pooling is undertaken then these predicted vehicle numbers will reduce.

Delivery of OSOM WTG components will take place from a commercial port facility located along the south east coast of Australia. The Port of Newcastle is the likely option, however other ports including (but not limited to) Port Botany and Port Kembla may be considered by the construction contractor. If the Port of Newcastle is selected, transport will occur via John Renshaw Drive, New England Highway, Golden Highway, Saxa Road, Mitchell Highway, Goolma Road, and Twelve Mile Road (from the western end only so as to avoid impacts to residents located on other parts of Twelve Mile Road or other minor roads). It is notable that although future commercial procurement decisions will largely determine the most suitable port of entry, other ports of entry can be used which would then link with the studied route. The nominated OSOM transport route will bypass the Central Business Districts (CBDs) of Dubbo, Wellington and Mudgee however some disruption to local traffic will occur at various points along the preferred transport route during peak construction times. The Heavy Vehicle Routes used by the Project through the surrounding towns and road network (although not defined) will be along the major road network and standard heavy vehicle road network, or alternatively along routes permitted by any resource supplier's permitting and approvals process. To minimise interruption to local traffic and ensure a high standard of road safety, a Traffic Management Plan (TMP) will be developed in consultation with the Roads Authorities and implemented throughout the construction phase of the Project.

Dubbo Regional Council have been consulted regarding the use of, and proposed road upgrades required to Twelve Mile Road which will form the primary Project Site entry for WTG deliveries and staff. A preliminary design of required upgrades has been prepared for the length of Twelve Mile Road from Goolma Road at the western end to the primary access point which proposes an upgraded road design to have a sealed dual lane road (one lane in each direction) of 3.1m lane width with additional passing bays at 1.5 km-2 km intervals. A short section of Uungula Road and Ilgingery Road will be used during construction and operational activities for OSOM, Heavy and Light Vehicles, which will gain access via the primary Project Site entry and Internal Roads, to access a small number of WTGs at the western edge of the layout.

A secondary point of access is proposed via Uungula Road and Ilgingery Road for a limited number of non-OSOM vehicles during the construction phase. Secondary intersections and cross-over locations would occur along Uungula and Ilgingery Roads. These secondary access points will facilitate the routes of Internal Roads throughout the Project Site required for construction and operational vehicles.

Project Site access points would be gated and secured, and appropriate warning signs erected. All access points will connect to new internal access roads which will be designed and constructed to facilitate secure access to each WTG site and the associated battery storage facilities.

It is considered that with appropriate road upgrades and suitable management measures, the Project would not create any significant adverse impacts with respect to transport issues. The management of heavy vehicle movements during construction would be appropriately covered by a TMP to be prepared prior to commencement of work, while the use of a specialised and licensed transport contractor would ensure that the transport of OSOM WTG components would be carried out in an appropriate manner. Based on the findings of the Transport Assessment (Samsa Consulting, 2020) and the Route Study (RJA, 2020), the impacts of the Project on the road system can be satisfactorily accommodated.

Hazards / Risks

An environmental hazard is an item or situation that has the potential to threaten the environment or human health. In responding to potential community concerns, the Project conforms to recognised technical guidelines identified within the SEARs to identify appropriate design considerations and mitigation strategies.

The Hazards and Risks chapter considers health and safety related impacts potentially arising from the Project and refers to the following subsections: -

Aviation

The aviation impacts arising from the Project have been assessed and documented by Aeronautical Impact Assessment, prepared by Landrum and Brown Worldwide (2020).

The findings of the report identified Mudgee Airport and Dubbo Airport, Wellington aerodrome (Bodangora aerodrome), and the Gulgong Aero Park are all located within 30 nautical miles (nm) to the Project site. There is also high probability for numerous other aviation activities associated with unlicensed private air strips, including one known grass runway within the site boundary and three known grass airstrips upon adjacent land.

The Project is not expected to have any impact on civil air traffic operating under either IFR or VFR but will rather act as a prominent feature which may assist in visual navigation. Pending favourable determination of the Project, the Proponent will provide CASA with WTG location and height details once final positions are known and before construction commences to ensure safety for aircraft, particularly is sited in areas with high air traffic, is a priority.

Telecommunications

The potential telecommunications and electromagnetic interference impacts arising from the Project have been assessed and documented by Middleton Group (2020). The assessment of impacts identifies the existing radio, telecommunications and communications systems already operating within the region. It also provides an assessment of the potential impacts and interference effects that may be caused by the Project. There is the potential for large structures, including WTGs, to introduce interference when they occur close to or within the signal path.

The findings of the assessment report highlight that there will be no impact on existing signals and communication systems within the area due to the Project. However, care should be taken with the installation of WTGs and amend planned WTG positions where necessary, and within the parameters of any consent, to ensure minimal interference with television and radio broadcasting. During the operational phase of the Project, in the unlikely case there is an occurrence of broadcasting interference, a system will be in place for recording complaints to allow for further investigation and to reach an amicable solution through mitigations.

Electromagnetic Fields

The occurrence of Electromagnetic Fields (EMFs) and the potential for radiation impacts arising from the Project have been assessed. In accordance with relevant guidelines, consideration is given to human health and safety, as well as potential interruption of existing services throughout the various stages of the Project.

EMFs are produced by electrical equipment of all sizes and voltages. Interestingly too, they also occur naturally, such as the build-up of electric charge in thunderstorms or within the Earth's magnetic field. EMFs generated from the Project would depend on the type and size of electrical equipment on site and whether potential sources are overhead or buried. Predicted electromagnetic levels are such that potential exposure on site would be below the National Health and Medical Research Council's (NHMRC) Interim Guidelines on limits of exposure. In limiting exposure to electromagnetic fields, following advice from the International Commission on Non-Ionizing Radiation Protection, priority would be given to engineering and access controls so that the final design would adhere to the relevant Australian standards, ensuring EMFs would be minimised as far as possible and that access to electrical equipment would be strictly limited to qualified personal only. To reduce the potential for chronic or acute exposure to electromagnetic fields, no unsupervised public access to the Project Site would be permitted. Electromagnetic fields are considered likely to be indistinguishable from background levels at the boundary of the site and therefore pose no risk to the general public and would not impact upon any nearby electrical devices.

Low Frequency Noise and Infrasound

An assessment of the occurrence of low-frequency noise (infrasound) and the potential for adverse health effects as a result of such was undertaken. The assessment considered the potential adverse health effects upon people within the vicinity of the Project and the wider community.

Aerodynamic sounds from WTGs include low frequency noise or infrasound that is caused when the WTG blades encounter localized air stream disturbance from the tower. Low frequency sound contains frequencies within the range of 20 Hz to 100 Hz and infrasound is sound with frequencies below 20 Hz. Aerodynamic noise produced by WTGs does produce some level of low frequency noise and infrasound; however, the actual sound levels at receivers greater than 200 m from the WTGs would not be perceptible to the human ear and consequently there is no evidence that infrasound below the hearing threshold causes physiological or psychological effects.

As low-frequency noise and infrasound is not actually identified as an adverse impact from the Project, there are no specific mitigation measures. Design principals have been incorporated to ensure site design complies with the NHMRC findings, including provisions for setbacks to dwellings and advances in WTG technology, resulting in significantly decreased infrasound noise levels that are well below the level of perception and acceptable noise levels for wind farm developments in rural areas in Australia.

Shadow Flicker and Blade Glint

The occurrence of shadow flicker and blade glint, potentially resulting in adverse impacts to surrounding residents and the wider community has been assessed by Moir Landscape Architecture (2020) in accordance with the *Wind Energy: Visual Assessment Bulletin* (DPE, 2016b).

Shadow flicker is the fluctuating light levels caused by intermittent (moving or changing) shadows and blade glint is the ability for natural light to be reflected from the surface of WTG blades, each potentially causing disruption or nuisance to observers. Analysis has been undertaken to determine the annual duration of shadow flicker experienced at dwellings in the vicinity of the Project. The theoretical shadow flicker modelling conducted at the site and included in the visual impact assessment, states no associated or non-associated dwellings are expected to exceed the limit recommended by the Draft National Guidelines and there is a negligible risk to passing motorists.

The mitigation measures relating to impacts from shadow flicker and blade glint are generic to all large-scale wind farm developments and includes design principals and technological advances in WTGs available at the time. The Shadow flicker at any dwelling should not exceed 30 hours per year unless a prior arrangement is in place with the effected landholder(s).

Energy Storage Facilities

An assessment of the ESF and its associated risks was undertaken. The ESF, which will most likely be lithium-ion battery based, will allow the Project to store and dispatch scheduled and reliable energy to and from the Project or the NEM. A preliminary hazard assessment and risk prioritisation considered lithium-ion batteries and found that not-insignificant but low-level hazards related to the BESS included electrocution, crushing and toxicity, whilst the medium level hazards included fire and explosion.

Bushfire & Electrical Fire

An assessment of the bushfire and electrical fire impacts arising from the Project was undertaken. The aims and objectives of the assessment was to identify risks and mitigation measures to reduce the likelihood of a fire impacting or spreading from the site, as well as incorporating appropriate bushfire emergency management planning.

The Project site varies from low to high bushfire risk as mapped under the NSW Rural Fire Service bushfire prone land mapping. The Bushfire Risk Assessment considers any existing fire hazards and potential fire risks associated with the Project, throughout the various stages of the development. By reviewing the possible ignition sources from the site and analysing potential risk to life and property (including WTGs) it is possible to create management strategies to minimise risk.

Mitigation measures, in accordance with the revised draft *Planning for Bushfire Protection 2019* guidelines, are proposed to reduce and manage any risks, and to lessen the impact of bushfires or electrical fires within or surrounding the Project. The mitigation measures encompass deign principles including improved access and maintenance of asset protection zones to 10m around WTGs, as well as implementation of best practice safety protocols documented in a detailed Fire Management and Emergency Response Plan.

Aboriginal Cultural Heritage

The Wiradjuri Aboriginal people occupy the land that is included within the Study Area. The people use the land for a range of hunting, fishing and gathering forays which were conducted as people moved throughout the country between the areas now known as Bathurst, Mudgee and Wellington.

There remains extensive evidence, inducing archaeological deposits, of the Wiradjuri peoples' occupancy of the land. The most common Aboriginal object recordings in the region are distributions of stone artefacts. Rare site types include rock shelters, scarred trees, quarry and procurement sites, burials, stone arrangements, contact sites and traditional story or other ceremonial places.

The process of Aboriginal community consultation has been undertaken in accordance the NSW Office of Environment and Heritage's (OEH) *Aboriginal Cultural Heritage Consultation Requirements for Proponents*, and has sought to identify and record Aboriginal cultural areas, objects or places, assess the archaeological potential of the Project Site and formulate management recommendations based on the results of the consultation, background research, field survey and, as applicable, significance assessment.

Registered Aboriginal Parties (RAPs) were forwarded an outline of the scope of the Project, the proposed cultural heritage assessment process and the heritage assessment methodology during the consultation process. Field surveys were attended by representatives of the RAPs from Wellington Valley Wiradjuri Aboriginal Corporation, Gallangabang Aboriginal Corporation, Murong Gialinga and Mudgee Local Aboriginal Land Council (LALC). The AHIMS is a database maintained by DPIE and regulated under Section 90Q of the NPW Act. AHIMS holds information and records regarding the registered Aboriginal archaeological sites (Aboriginal objects, as defined under the Act) and declared Aboriginal places that exist in NSW. Searches of the AHIMS database conducted on 31 March 2020 and 1 April 2020 each identified 84 Aboriginal sites recorded giving a total of 168 recorded Aboriginal sites and no Aboriginal places. Following further spatial analysis, 10 sites were identified as occurring within the Development Footprint, and 2 within the vicinity of the Development Footprint.

Field surveys identified in excess of 370 stone artefacts across 42 Aboriginal object sites. The assessment found that the majority of Aboriginal object sites recorded during the study are situated outside the Development Footprint and would be unlikely to be harmed during construction, however, to allow potential impacts associated with micro-siting and other necessary ancillary actions, mitigation measures will be implemented, as required, throughout the Development Corridor.

Given the relatively small Development Footprint, the nature and density of the artefacts' locales recorded and the low cultural and scientific significance rating, it was determined that unmitigated impacts are appropriate in many cases.

Cultural heritage impacts will be managed through the development of a Cultural Heritage Management Plan, which shall document the procedures to be followed for impact mitigation and management. The development of an appropriate Cultural Heritage Management Plan should be undertaken in consultation with an archaeologist, the Registered Aboriginal Parties and the NSW DPIE. It would aim to provide clear guidance as to allowable impacts and to ensure the effectiveness and reliability of mitigation and management strategies which may include subsurface testing and/or salvage, if required. The Cultural Heritage Management Plan would set out the procedures to be adopted in the unlikely event that human remains or unexpected Aboriginal objects are found during construction.

Mitigation measures and recommendations identified within the CHMP shall be incorporated into Environmental Management Plans and Environmental Management Systems.

Historic Heritage

The historic heritage assessment was undertaken in accordance with the _NSW Heritage Manual_ (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996), specifically the guidelines _Assessing Significance for Historical Archaeological Sites and 'Relics'_ (Heritage Branch Department of Planning, 2009), and with reference to the Burra Charter (the Australian ICOMOS Charter for Places of Cultural Significance) (ICOMOS (Australia), 2013).

A search of relevant databases revealed that there are no heritage items within the Project Site listed on the Australian Heritage Database. A search of the Wellington LEP 2012 revealed that while there are various items listed as historic heritage of local significance within 5 km of the Project Site, there are no heritage items currently listed within the Project Site. Austral Archaeology identified an excavated shaft, set approximately 15 metres north of the main creek line in Survey Area 19 (Appendix J). This had large stones forming a collar above rounded logs placed in the shaft. It was estimated to be less that ten metres deep with water at the bottom and was presumed to be a well rather than a mine. Austral Archaeology conclude that the structure may be of historical significance and recommend recording before works proceed. No historic other heritage items or relics were recorded in the Project Site.

Mitigation measures include recording and assessing the historical significance of the well should works proceed nearby. If other potential historic heritage is identified all work within a 10 m radius of the site will cease and advice sought from an historic archaeologist. If required, notification under Section 146 of the Heritage Act would be undertaken and works would not recommence in the area until permitted.

Water and Soils

The Project Site is located within the Macquarie River Catchment area upon an elevated ridgeline ranging from 359 to 705 m (AHD), with topography of the Project Site generally gently undulating with numerous valley and peaks. The land is zoned as RU1 Primary Production, with existing land management practises predominately consisting of sheep and cattle grazing with improved pastures and cropping found throughout. Land condition states reflect the current and past land uses with a vast majority of the area being extensively cleared with few areas of intact remnant vegetation remaining. Watercourses within the Project Site are predominantly ephemeral. The presence of sodic sub-soils and areas of >3% slopes on the Project Site pose a high erosion risk when disturbed through clearing and earthworks.

Community consultation identified concerns regarding water and soils, including dust generation, erosion risks and adequate water supplies. The Project has responded to these concerns through a design evolution process that seeks to minimise the Development Footprint, while maintaining power generation capacity.

Wind harvesting is a passive land use that can co-exist with grazing activities, which are expected to continue concurrently throughout the Project lifespan with land being rehabilitated upon project decommissioning. As such, the Project will not compromise or significantly diminish the availability of land for primary production purposes within the Project Site or surrounding Dubbo Regional Council LGA.

Proposed construction works involve a range of activities that disturb soils and could potentially lead to erosion and sediment laden runoff, affecting water quality. Relevant Australian and New Zealand Environment Conservation Council (ANZECC) guidelines of Upland Rivers will form initial monitoring targets throughout the construction phase of the Project. The installation of roads, pads and other infrastructure for the Project has the potential to change hydrology and flood behaviour. Although hydrological monitoring shows the majority of the Project Site is not prone to sheet flow erosion due to the high relief of the terrain, modelling indicates the potential for erosion of drainage lines, and this should be considered in detailed design. Groundcover will be retained where possible and areas of high erosional potential identified within this environmental assessment. Revegetation of riparian corridors is recommended in conjunction with the construction works which would increase vegetated cover across the Project Site and ultimately create a buffer between wind farm activities and watercourses.

The construction of WTGs, access tracks and ancillary structures (including cable crossings) have the potential to disrupt aquatic ecosystems, predominately where these structures cross or are within close vicinity to waterways. Where it is necessary for infrastructure to cross waterways, construction should occur (if possible) during periods of no-flow to minimise impacts to aquatic ecosystems. Access tracks and cable crossings should be designed in accordance with *Policy and guidelines for fish habitat conservation and management* (Fairfull, 2013), *Guidelines for watercourse crossings on waterfront land* (DPI Water, 2012) and *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge, 2003).

Water requirements will be met in accordance with the provisions of the *Water Management Act 2000* (WM Act) by sourcing water from within the locality where practicable, using existing onsite dams or from groundwater purchased from involved or adjacent landowner properties who hold relevant licenses and unused allocations.. If it is not practicable to source water locally, then it will be brought to the Project Site by external water suppliers under contract to the Project.

This assessment has concluded there is limited potential for surface and groundwater quality impacts associated with the construction, operation and decommissioning of the Project. The preparation and implementation of an Erosion and Sediment Control Plan (in accordance with Landcom (2004)) prior to commencing construction should occur to reduce impacts to water quality as a result of construction activities.

Resource Requirements and Waste

The Project has aimed to adopt appropriate waste principles to encourage the efficient use of resources, minimise environmental harm, comply with the project SEARs and legal requirements under the POEO and WARR Acts. Throughout the Project design evolution process, the Development Footprint has been minimised, providing a corresponding reduction in resource requirements and waste production.

Resource requirements for the Project including the provision of cement, aggregate, sand, asphalt, water and road base material will be sourced locally where practical. In addition, required quantities of the Project have been identified as unlikely to place significant pressure on necessary resources.

Mitigation measures for potential impacts of the Project will be managed throughout the life of the project according to the following hierarchy:

1. Reduce waste production;
2. Recover resources (including reuse, reprocessing, recycling and energy recovery); and
3. Dispose of waste appropriately.

To achieve this, a Waste Management Plan (WMP) will be developed and implemented during construction, operation and decommissioning.

Socio-Economic Factors

The Project has been designed to align strongly with the principles of ESD, particularly inter-generational equity. In accordance with these principles, the Proponent has integrated social, economic and environmental considerations in developing the Project to minimise potential impacts. These outcomes have been realised over more than nine years of ongoing consultation that has been reflected in the ongoing evolution of the Project Design.

The socio-economic and environmental benefits of developing renewable energy sources, and transitioning to a low carbon future are large, providing potential benefits to entire communities and helping to maintain quality of life in the longer term. Increased adoption of renewable energy sources will assist Australia to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and carbon emissions associated with climate change. Reduced carbon emissions have the potential to reverse or slow the effects of climate change, benefitting current and future generations.

Electricity produced from the Project provides a clean power source for local and regional consumers in a cost-effective manner. The Project would produce clean renewable energy to the local electricity transmission network, providing enough energy to power up to 170,000 average NSW homes each year. Moreover, the inclusion of an ESF will allow for the Project to store and dispatch scheduled and reliable energy to and from the Project or the NEM. This would reduce up to 1 million tonnes of CO_2 per annum through the displacement of conventional electricity supply.

The Project would have an overall positive impact on the local and wider economy during both the construction and operational period. In particularly, the Project will have the following economic benefits:

- **Direct and Indirect Employment:** The Project will support 250 direct and 400 indirect FTE positions over the construction period. Once operational, 12 direct and 35 indirect FTE jobs will be supported by the Project.
- **Industry and Business Participation Opportunities:** The Project will be able to maximise local business participation through contracted work.
- **Local Wage Spending Stimulus:** Non-local construction workers living in the region would be expected to inject approximately $5.6 million in additional spending to the regional economy over the construction phase, supporting approximately 28 FTE jobs in the service sector.
- **Ongoing Economic Stimulus:** The Project will be making approximately $180 million in payments over 30 years to associated landholders.
- **Returns to Council and the Community:** Increases in Council rates caused by the Project and community benefit contributions (discussions ongoing) and community co-investment opportunities which will be subject to market testing post Development Consent.

The Project will also have a number of social benefits including the potential for the community to directly invest in the Project. Host landowner properties will also benefit from the Project through the construction of new internal roads which reduce bushfire risks and decrease the likelihood of loss of buildings, machinery, livestock and fencing.

Several other major projects, including those associated with renewable energy generation have been approved, and are either in operation or are due for construction, in locations which surround the study area and are likely to have completed construction by the time the Project will commence. As such, the Project will provide new opportunities for local workers and contractors who have gained skills and experience on previous solar and wind farm projects.

Community impacts associated with adverse health impacts to individuals living near wind farms has been refuted through research by the NHMRC, which has concluded that there is currently no consistent evidence that wind farms cause adverse health effects in humans (NHMRC, 2015).

Cumulative Impacts

Other major and renewable energy projects within the vicinity include:

- Bodangora Wind Farm (operating);
- Crudine Ridge Wind Farm (under construction);
- Liverpool Range Wind Farm (approved); and
- Flyers Creek Wind Farm (approved).

For all other identified projects, the combined effect of temporal and spatial separation between the Project and other developments occurring, or proposed to occur, in conjunction with project specific mitigation measures are considered appropriate to satisfactorily mitigate potential cumulative impacts.

Environmental Management

An Environmental Management Strategy (EMS) would be prepared to provide an overall framework for the management of environmental impacts that could potentially arise during each stage of the Project.

The Project would be designed, constructed, operated and decommissioned in accordance with the requirements of:

- Relevant legislation;
- Conditions of consent; and
- Commitments provided in this EIS (and subsequent development application documentation).

Conclusion

The Project has been developed and refined within the context of the Avoid-Minimise-Mitigate-Offset hierarchy. Throughout its evolution the proponent has sought to consult with stakeholders and respond to matters raised. The resultant Project aligns with the principles of ecologically sustainable development, particularly intergeneration equity, in providing a clean and reliable energy source for future generations. Located with the NSW Central West Renewable Energy Zone, the Project aligns with local, state, national and international targets and intentions to move away from fossil fuels in a structured and strategic manner.

Environmental impacts associated with the construction, operation and decommissioning of the Project are compliant with the requirements for SSD under the EP&A Act and other relevant State and Commonwealth legislation. Potential environmental impacts are relatively minor and can be appropriately managed through the application of identified mitigation strategies and ongoing stakeholder consultation. Potential benefits associated with the Project are a substantial reduction in greenhouse gas emissions, reduced reliance on non-renewable energy sources and positive outcomes for the local community. On this basis the Project is strongly justified.

1 Introduction

1.1 Context

Throughout the world there is growing concern regarding measured changes to climate and the potential for these changes to impact on the global biomes, in which all life on earth exists.

There is substantial scientifically verified, evidence that the Earth's climate is changing in response to both natural and anthropogenic substances and processes (IPCC, 2018). Australia faces significant social, environmental and economic impacts from such climate change, across a number of sectors including water security, agriculture, coastal communities and infrastructure (DoEE, n.d.).

A range of responses are required to effectively mitigate climate change. Transitioning to low carbon emission electricity generation technologies, including renewable energy technologies such as solar and wind, is one of the sector transformations required to address climate change (IPCC, 2018).

Australia is a signatory to a number of international agreements, conventions and protocols regarding climate change and the reduction of greenhouse gas emissions, including the 2015 Paris Agreement to reduce CO_2 emissions to 26% - 28% below 2005 levels by 2030 (DoEE, 2017). In addition, New South Wales (NSW) has committed to an aspirational target of achieving net-zero emissions by 2050.

Access to electricity is essential for the maintenance and improvement of living standards. Demand for clean, renewable energy sources will continue to grow for the foreseeable future as governments and consumers respond to the threat of climate change and act to actively reduce carbon emissions.

The NSW Government has announced its intention to create renewable electricity zones (REZ's) to facilitate the ongoing development and uptake of renewable energy sources as part of an orderly transition towards renewable energy. Of particular relevance, a pilot REZ has been announced, seeking to attract 3,000 megawatts (MW) of investment in the state's central west. The proposed Uungula Wind Farm (the 'Project') is located within the Central West REZ, and is estimated to have an installed generating capacity of approximately 400 MW, producing enough energy to power the equivalent of 170,000 average NSW households each year and displacing up to 1.1 million tonnes of CO_2 annually.

1.2 Purpose of this document

This Environmental Impact Statement (EIS) has been prepared for CWP Renewables (CWPR) on behalf of Uungula Wind Farm Pty Ltd (the 'Proponent') to support a Development Application to build and operate a wind farm. The Project is proposed to be located in the Dubbo Regional Council Local Government Area (LGA) between Wuuluman and Twelve Mile, approximately 14 km east of Wellington, NSW. The Project consists of the installation, operation, maintenance and decommissioning of up to 97 Wind Turbine Generators (WTGs), an Energy Storage Facility (ESF), Ancillary Infrastructure and Temporary Facilities. The Project is designed to accommodate a contemporary WTG of up to 250 m in height, with a nameplate capacity of approximately 4 MW or greater. On these terms, and subject to Development Consent and market changes, the Project is estimated to have an installed generating capacity of approximately 400 MW.

Additionally, inclusion of an ESF will allow for the Project to store and dispatch scheduled and reliable energy to and from the Project or the National Electricity Market (NEM).

The Project has a capital investment value above $30 million. Under the *State Environmental Planning Policy (State and Regional Development) 2011* (SEPP(SRD)), electricity generating works (including wind power) that have a capital investment value of more than $30 million are classified as "State Significant Development" (SSD) and require approval under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) through the preparation of an EIS.

As such, this EIS has been prepared under Part 4 of the EP&A Act, in accordance with the Secretary's Environmental Assessment Requirements (SEARs), dated 11 November 2019 (Appendix A), and the requirements of Schedule 2 of the *Environmental Planning and Assessment Regulation 2000* (EP&A Regulation).

Under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Matters of National Environmental Significance (MNES) are protected. The EPBC Act requires approval for significant impacts upon MNES to be approved by the Commonwealth Minister for the Environment. The potential for impacts to MNES are considered throughout this EIS, and the likely significance of potential impacts are presented in Section 8.4. The Project was originally referred to the Australia Government Environment Minister in 2013 and was deemed a Controlled Action. Confirmation was sought to determine if the Proposed Action could be assessed under the Bilateral Agreement. Confirmation was received in 2017 (Appendix B).

1.3 Project Overview

The Project generally consists of the installation, operation, maintenance and decommissioning of up to 97 WTGs, an ESF, Ancillary Infrastructure and Temporary Facilities, and is estimated to have an installed generating capacity of approximately 400 MW. The Project will connect to the 330 kV transmission line running in approximately east-west within the northern part of the Project Site.

1.4 Project Setting

The Project is located in the Central-West REZ, within the Dubbo Regional Council LGA, 14 km east of Wellington, within the NSW Central West (Figure 1-1).

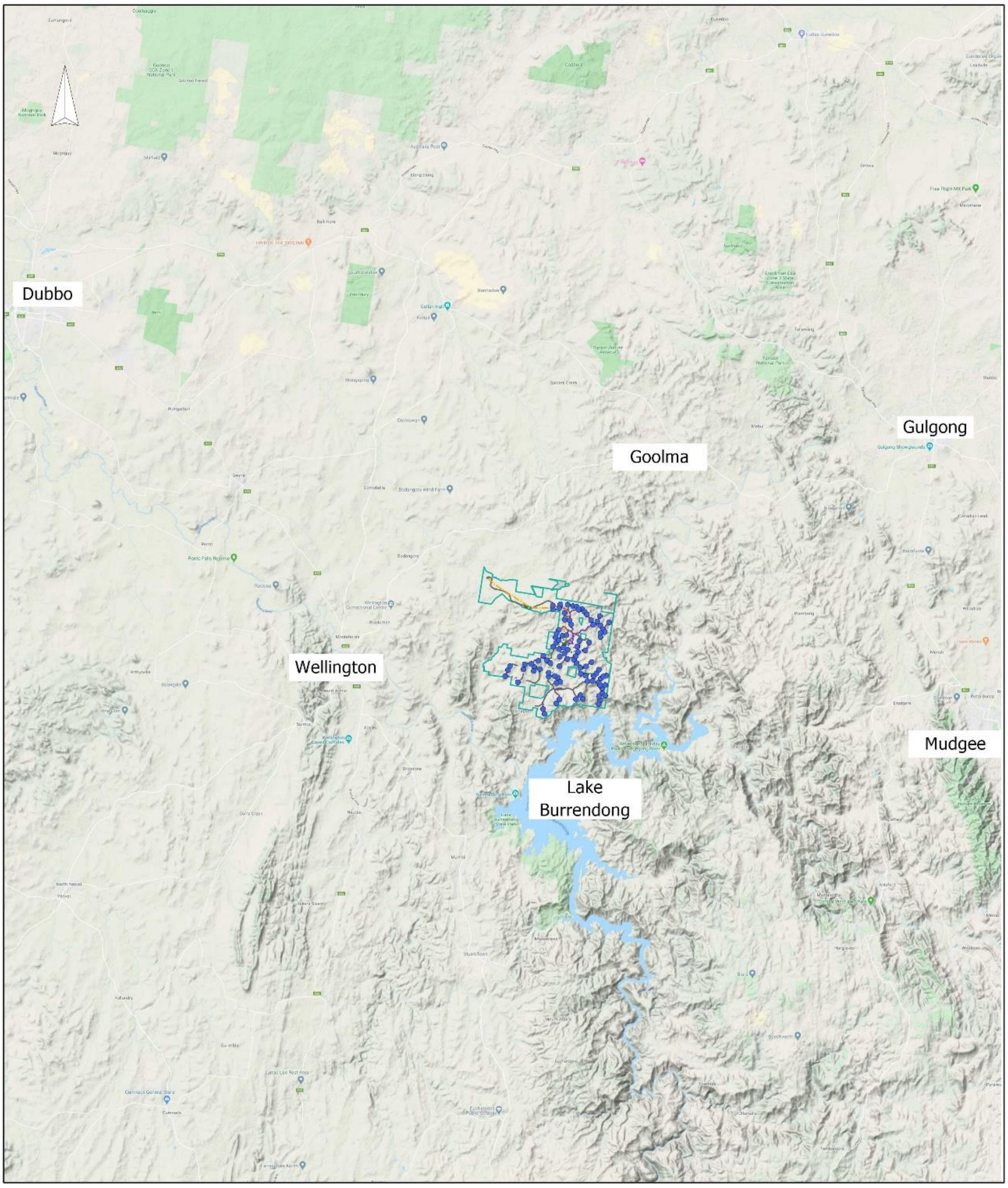
The region is dominated by agriculture; including sheep, cattle and goat grazing, cropping for stock feed and sheep studs. Renewable energy projects have also entered the landscape since 2017, including the operational Bodangora wind farm located 7 km north of the Project Site and the operational Beryl solar farm located 30 km east. Other approved, but yet to be constructed, solar farm developments are also located in proximity to the Project, including the Wellington Solar Farm approximately 30 km north west of the Project Site and the Maryvale Solar Farm approximately 28 km north west of the Project Site.

The town of Wellington, located approximately 14km west of the Project, is the nearest population centre with the small village of Goolma located approximately 16 km north of the Project. Other towns near the Project include Gulgong and Mudgee, approximately 35 km and 36 km to the north east and east respectively. Lake Burrendong is located to the south of the Project, which is part of the Water NSW bulk water storage complex which drains into the Macquarie River. The majority of the Project Site drains into local tributaries feeding ultimately into Lake Burrendong.

The Project layout will be developed within the boundaries of the Project Site shown in Figure 1-1 and schedule of land shown in Appendix C. The schedule of land comprises freehold lots, Crown land, Crown waterways, unformed Crown roads and unformed Council roads. Indicative centre point coordinates of each WTG are provided in Appendix D.

Figure 1-2 provides the Project layout, illustrating WTGs, ESF and Ancillary Infrastructure (including all access tracks and waterway crossings). Detailed mapping is provided in Appendix E.

Development Approval is sought for the Project, with post operational activities to include the decommissioning of the Project and returning of the Project Site to a suitable condition to allow the resumption of agricultural activities.



LEGEND

- Wind Turbine Generator (97)
- Project Site
- Wind farm access tracks
- Site Compound
- Substation
- Energy Storage Facility

Proposed Powerlines:
- Underground (medium to low voltage)
- Overhead (medium to low voltage)
- Overhead (high voltage)

SCALE BAR

0 10 km

COMPANY				
UUNGULA WIND FARM PTY LTD				
TITLE				
Project Location				
DATE	SCALE	DWG NO	REV	VER
17/04/2020	1:420000	UWF-048	A	1
DRAWN BY	CHECKED BY	SHEET	JOB NO	SIZE
J PETERSEN	M FLOWER	1 OF 1	110247	A3

Figure 1-1: Project location

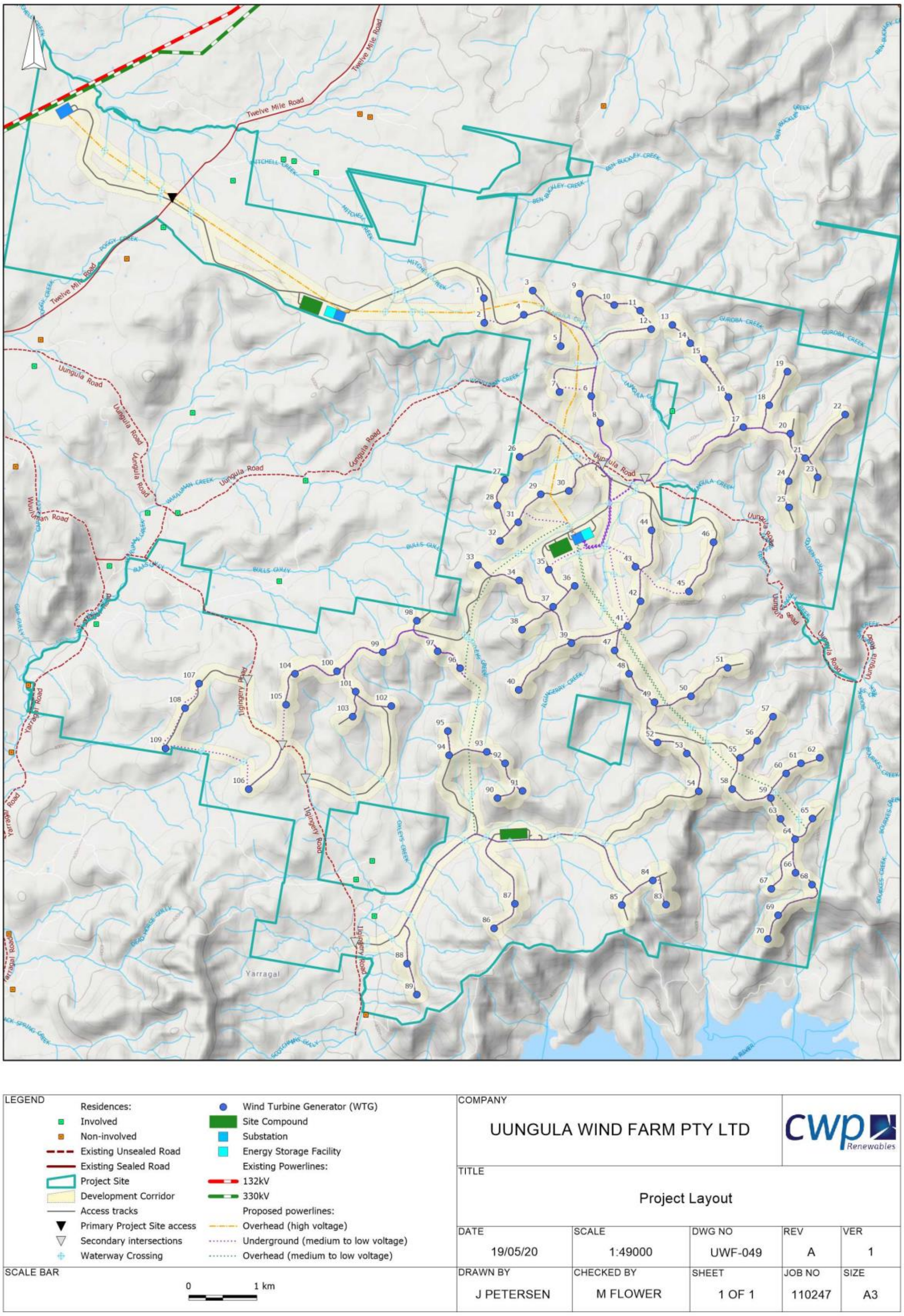


Figure 1-2: Project layout (indicative)

1.5 The Proponent

CWPR is an industry leading developer, builder and operator of large-scale renewable energy projects. CWPR's track record includes the successful construction and operation of seven large-scale renewable energy projects totalling 1,524 MW of generation across Europe (763 MW) and Australia (761 MW).

CWPR's organisational capacity to deliver the Project builds upon this proven track record and close understanding of the market environment having brought to financial close three greenfield renewable energy projects totalling 645 MW since December 2016.

The proposed Uungula Wind Farm development is the sixth renewable energy project CWPR has brought through the NSW planning assessment process.

1.6 Structure of the EIS

This EIS has been prepared in accordance with the EP&A Act, EP&A Regulation, the SEARs (outlined in Table 1-1 and Appendix A) and all other relevant legislation to support the application for approval. The purpose of this EIS is to:

- provide the consent authority with sufficient information, in regard to the benefits and potential environmental impacts of the Project, to make an informed decision;
- provide the community with sufficient information about the Project; and
- provide measures to reduce any potential environmental impact associated with the Project.

As part of this assessment, numerous technical studies were undertaken to inform the EIS. A summary of the technical consultants and which assessment each completed is provided in Table 1-2. The structure of the EIS is outlined in Table 1-3.

Table 1-1: Secretary's Environmental Assessment Requirements for the Project

Issue	Requirement	Section in EIS
General Requirements	• A stand-alone executive summary	Executive Summary
	• A full description of the development, including: ○ Details of construction, operation and decommissioning, including any proposed staging of the development or refurbishing of turbines over time; ○ all infrastructure and facilities, such as substations, transmission lines, construction compounds, concrete batching plants, internal access roads, and road upgrades (including any infrastructure that would be required for the development, but the subject of a separate approvals process); ○ Site plans and maps at an adequate scale with dimensions showing: - the location and dimensions of all project components including coordinates in latitude / longitude and maximum AHD heights of the turbines; - existing infrastructure, land use, and environmental features in the vicinity of the development, including nearby residences and approved residential developments or subdivisions within 5 km of a proposed turbine, and any other existing, approved or proposed wind farms in the region; and - the development corridor that has been assessed, including any allowance for micro-siting of turbines and identification of the key environmental constraints that have been considered in the design of the development. ○ Details of the progressive rehabilitation of the site.	Section 4
	• A list of any approvals that must be obtained before the development may commence.	Section 5.5
	• The terms of any proposed voluntary planning agreement with the relevant local council.	None available during the preparation of this EIS
	• An assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including: ○ a description of the existing environment likely to be affected by the development using sufficient baseline data; ○ An assessment of the likely impacts of all stages of the development, taking into consideration any relevant	Section 8

Issue	Requirement	Section in EIS
	legislation, environmental planning instruments, guidelines, policies, plans, industry codes of practice and including the *NSW Wind Energy Guideline for State Significant Wind Energy Development* (2016); ○ a description of the measures that would be implemented to avoid, mitigate and/or offset residual impacts of the development and the likely effectiveness of these measures, including details of consultation with any affected non-associated landowners in relation to the development of mitigation management measures, and any negotiated agreements with these landowners; and ○ a description of the measures that would be implemented to monitor and report on the environmental performance of the development, including adaptive management strategies and contingency measures to address residual impacts.	
	• A consolidated summary of all the proposed environmental management and monitoring measures, identifying all the commitments in the EIS.	Section 9
	• The reasons why the development should be approved having regard to: ○ relevant matters for consideration under the *Environmental Planning and Assessment Act 1979*, including the objects of the Act, evaluation of the merits of the project as a whole and how the principles of ecologically sustainable development have been incorporated in the design, construction and ongoing operations of the development; ○ the environmental, economic and social costs and benefits of the development, having regard to the predicted electricity demand in NSW and the National Electricity Market, the Commonwealth's Renewable Energy Target Scheme, and the greenhouse gas savings of the development; ○ a detailed consideration of the capability of the project to the security and reliability of the electricity system in the National Electricity Market, having regard to local system conditions and the Department's guidance on the matter; ○ the suitability of the site with respect to potential land use conflicts with existing and future surrounding land uses, including rural villages, rural dwellings, subdivisions, land of high scenic value, conservation areas (including National Parks / Reserves), strategic agricultural land, state forests, mineral resources, triangulation stations, tourism facilities, existing or proposed wind farms, and the capacity of the existing electricity transmission network to accommodate the development; and ○ feasible alternatives to the development (and its key	Section 3

Issue	Requirement	Section in EIS
	components), including the consequences of not carrying out the development.	
	In addition to the matters set out in Schedule 1 of the *Environmental Planning and Assessment Regulation 2000*, the development application must be accompanied by a signed report from a suitably qualified person that includes an accurate estimate of the capital investment value of the development (as defined in Clause 3 of the *Environmental Planning and Assessment Regulation 2000*).	Submitted separately to this EIS
	Landscape and Visual	
	The EIS must include a detailed assessment of the visual impacts of all components of the project (including turbines, transmission lines, substations, and any other ancillary infrastructure) in accordance with the *Wind Energy: Visual Assessment Bulletin* (DPE, 2016b).	Section 8.2
	Noise and Vibration	
	The EIS must: • assess wind turbine noise in accordance with the *NSW Wind Energy: Noise Assessment Bulletin* (EPA/DPE, 2016c); • assess noise generated by ancillary infrastructure in accordance with the *NSW Noise Policy* for *Industry* (EPA, 2017); • assess construction noise under the *Interim Construction Noise Guidelines* (DECC,2009); • assess traffic noise under the *NSW Road Noise Policy* (DECCW, 2011); and • assess vibration under the *Assessing Vibration: A Technical Guideline* (DECC, 2006).	Section 8.3
	Biodiversity	
Key Issues	The EIS must: • assess biodiversity values and the likely biodiversity impacts of the development in accordance with the *NSW Biodiversity Offsets Policy for Major Projects* (OEH, 2014) and *Framework for Biodiversity Assessment* (OEH, 2014), unless otherwise agreed by the Biodiversity and Conservation Division (BCD) (terrestrial biodiversity) or DPI Fisheries (aquatic biodiversity); and • assess the impact of the development on birds and bats, including blade strike, low air pressure zones at the blade tips (barotrauma), alteration to movement patterns, and • cumulative impacts of other wind farms in the vicinity.	Section 8.4
	Traffic and Transport	
	The EIS must: • assess the construction, operational and decommissioning traffic impacts of the development; • provide details of traffic volumes (both light and heavy vehicles) and transport routes during construction, operation and decommissioning, including traffic associated with sourcing raw materials (water, sand and gravel);	Section 8.5

Issue	Requirement	Section in EIS
	• assess the potential traffic impacts of the project on road network function (including intersection performance and site access arrangements and road safety, including school bus routes and school zones; • assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the project (including over-mass / over-dimensional traffic haulage • routes from port) during construction, operation and decommissioning; • an assessment of the likely transport impacts to the site access and haulage routes, site access point, any rail safety issues, any Crown land, particularly in relation to the capacity and conditions of the roads; • provide details of measures to mitigate and / or manage potential impacts including a schedule of all required road upgrades (including resulting from over mass / over dimensional traffic haulage routes), road maintenance contributions, and any other traffic control measures, developed in consultation with the relevant road authority.	
	Hazard / Risks	

	The EIS must include an assessment of the following:
	• Aviation Safety:
	  ○ assess the impact of the development under the _National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft_;
	  ○ provide associated height and co-ordinates for each turbine assessed;
	  ○ assess potential impacts on aviation safety, including cumulative effects of wind farms in the vicinity, potential wake / turbulence issues, the need for aviation hazard lighting, considering, defined air traffic routes, aircraft operating heights, approach/departure procedures, radar interference, communication systems, navigation aids;
	  ○ identify aerodromes within 30 NM of the turbines and consider the impact to nearby aerodromes and aircraft landing areas;
	  ○ address impacts on obstacle limitation surfaces, and
	  ○ assess the impact of the turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the turbines and transmission line.
	• Telecommunications:
	  ○ identify possible effects on telecommunications systems, assess impacts and mitigation measures including undertaking a detailed assessment to examine the potential impacts as well as analysis and agreement on the implementation of suitable options to avoid potential
		Section 8.6

Issue	Requirement	Section in EIS

	disruptions to radio communication services, which may include the installation and maintenance of alternative sites.
	• Health:
	  ○ consider and document any health issues having regard to the latest advice of the National Health and Medical Research Council, and identify potential hazards and risks associated with electric and magnetic fields (EMF) and demonstrate the application of the principles of prudent avoidance.
	• Bushfire:
	  ○ identify potential hazards and risks associated with bushfires / use of bushfire prone land, including the risks that a wind farm would cause bush fire and any potential impacts on the aerial fighting of bush fires and demonstrate compliance with *Planning for Bush Fire Protection 2006* (if located on bushfire prone land).
	• Blade Throw:
	  ○ assess blade throw risks, including potential interactions with battery storage;
	• Battery Storage:
	  ○ including a preliminary risk screening in accordance with *State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying SEPP 33* (DoP, 2011) and if the preliminary risk screening indicates the development is "potentially hazardous", a Preliminary Hazard Analysis (PHA) must be prepared in accordance with *Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis* (DoP, 2011) and *Multi-Level Risk Assessment (DoP, 2011).*	

	Heritage	
	The EIS must: • assess the impact on Aboriginal cultural heritage impact (archaeological and cultural) in accordance with the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW (*OEH, 2011) and the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW, 2010); • provide evidence of consultation with Aboriginal communities in determining and assessing impacts, developing options and selecting options and mitigation measures (including the final proposed measures), having regard to the *Aboriginal Cultural Heritage Consultation Requirements for Proponents* (DECCW, 2010); and • assess the impact on historic heritage having regard to the *NSW Heritage Manual.*	Section 8.7
	Water and Soils	
	The EIS must:	Section 8.9

Issue	Requirement	Section in EIS
	• quantify water demand, identify water sources (surface and groundwater), including any licensing requirements, and determine whether an adequate and secure water supply is available for the development; • access potential impacts on the quantity and quality of surface and groundwater resources, including impacts on other water users and watercourses; • where the project involves works within 40 metres of the high bank of any river, lake (including wetlands) or estuary (collectively waterfront land), identify likely impacts to the waterfront land, and how the activities are to be designed and implemented in accordance with the DPI *Guidelines for Controlled Activities on Waterfront Land* (2018) and (if necessary) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (DPI, 2003); and • describe the measures to minimise surface and groundwater impacts, including how works on steep gradient land or erodible soils types would be managed and any contingency requirements to address residual impacts.	
	Waste	
	The EIS must: • identify, quantify and classify the likely waste stream to be generated during construction and operation, and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste.	Section 8.10
Consultation	During the preparation of the EIS, you should consult with relevant local, State and Commonwealth Government authorities, service providers, community groups and affected landowners (including holders or applicants of mineral exploration licences, quarry operators and mineral title holders). In particular, you must: • establish a Community Consultative Committee for the project in accordance with the *Community Consultative Committee Guidelines for State Significant Projects*, and consult with the committee during the preparation of the EIS; and • carry out detailed consultation with the following: ○ Mid-Western Regional Council ○ Dubbo Regional Council ○ Office of Environment and Heritage ○ Biodiversity and Conservation Division ○ Department of Industry - Resources and Energy ○ Department of Primary Industries (Office of Water, Fisheries and Agriculture) ○ Roads and Maritime Services - Western Region ○ Central Tablelands Local Land Services ○ NSW Rural Fire Service	Section 6

Issue	Requirement	Section in EIS
	○ Department of Defence ○ Civil Aviation Safety Authority ○ AirServices Australia The EIS must include a description of what consultation was carried out during the preparation of the EIS, identify the issues raised during this consultation, and explain how these issues have been addressed in the EIS.	

Table 1-2: Technical consultants involved in the Project

Technical Assessment	Technical Consultant
Landscape and Visual	Moir Landscape Architecture Pty Ltd
Noise and Vibration	Sonus Pty Ltd
Biodiversity	Eco Logical Australia Pty Ltd
Traffic and Transport	• Twelve Mile Road Preliminary Design: iCubed Consulting Pty Ltd • Route Study: Rex J Andrews Pty Ltd • Transport Assessment: Samsa Consulting Pty Ltd
Hazards / Risks	• Preliminary Risk Screening: Arup Australia Pty Ltd • Aeronautical Impact Assessment: Landrum & Brown Worldwide (Aust) Pty Ltd • Telecommunications and Electromagnetic Interference Study: Middleton Group Pty Ltd • Bushfire Risk Assessment: Eco Logical Australia Pty Ltd
Heritage	• Aboriginal Cultural Heritage Assessment Report: New South Wales Archaeology Pty Ltd • Aboriginal Archaeological Survey Report: Austral Expert Services Pty Ltd T/a Austral Archaeology • Historic Heritage Assessment: Eco Logical Australia Pty Ltd
Water and Soils	Eco Logical Australia Pty Ltd
Waste	Eco Logical Australia Pty Ltd
Socio-Economic Factors	Ethos Urban Pty Ltd

Table 1-3: EIS structure

Section	Section Name	Content
1	Introduction	Project overview.
2	Alternatives Considered	Strategic needs for the Project, Project objectives, alternatives considered and justification.
3	Project Justification	As a conclusion to the environmental assessment, the construction, operation and decommissioning of the Project is evaluated and justified through the consideration of triple-bottom-line considerations (environment, community, and economics) and its potential benefits to the local, regional and NSW community.
4	Description of the Project	Description of the Project design, construction activities, operation and ancillary facilities.
5	Statutory and Planning Framework	Review of applicable local, State and Commonwealth legislation and policies.
6	Stakeholder and Community Consultation	Provides an overview of the stakeholder and community consultation undertaken to date, and a summary of future consultation during the approval process.
7	Environmental Risk Assessment	Provides an environmental risk analysis for all potential environmental impacts that have been considered within this EIS.
8	Environmental Assessment	Assessment of potential environmental impacts including visual, noise and vibration, biodiversity, traffic, hazards and risks, heritage, water and soils, waste and socio-economic and cumulative impacts.
9	Environmental Management	Recommended environmental mitigation measures and residual environmental risk assessment.
10	Conclusion	Provides a summary of the overall potential environmental impacts associated with the construction, operation and decommissioning of the Project and a statement confirming the Project is compliant with the requirements for SSD under the EP&A Act and other relevant State and Commonwealth legislation.
11	References	References used throughout this assessment.

2 Alternatives considered

2.1 Rationale

The Project will increase Australia's renewable energy generating capacity and assist in meeting commitments and obligations under international conventions and agreements to reduce CO_2 emissions.

The Project is also aligned with the principles of Ecologically Sustainable Development (ESD), particularly that of inter-generational equity, whereby the present generation makes land and resource use decisions, such as the transition of the electricity sector away from a reliance on coal and gas fired power stations to renewable technologies, to ensure that resources and environmental values are conserved for use by future generations. The environmental benefits of developing renewable energy sources and transitioning to a low carbon future are manifold, providing potential benefits to the entire community and helping to maintain quality of life.

In accordance with the principles of ESD, the Proponent has integrated social, environmental and economic considerations in developing the Project to minimise potential impacts while maintaining or enhancing positive outcomes for the greater community. These outcomes have been realised over more than nine years of ongoing consultation and analysis that has been reflected in an iterative design process that responds to the Avoid-Minimise-Mitigate-Offset hierarchy and is central to this EIS.

The outcomes of this approach have provided tangible reductions in both direct and indirect negative impacts to adjoining and nearby landholders, however, consultation activities continue to ensure residual impacts are appropriately mitigated.

2.2 Do Nothing Scenario

Under the Do-Nothing Scenario, the Project would not take place and the benefits resulting from the opportunity to generate additional renewable energy and reduce CO_2 emissions by 1.1 million tonnes per year, would be forgone. Furthermore, the local socio-economic benefits resulting from the Project, such as supporting 250 direct and 400 indirect Full-time equivalent (FTE) positions over the construction period and 12 direct and 35 indirect FTE jobs during operation, would be lost.

2.3 Alternative Locations

In defining the Project as a development opportunity, CWPR has evaluated a range of other sites across the NEM for both wind and solar generation opportunities, which may be considered as alternatives to the Project. Some of these sites are being progressed as they are deemed appropriate developments; other prospective sites have been considered, but discarded owing to a range of reasons.

Further decisions around alternative design with regard to the Project will be made post-approval during detailed design, with a view to minimising environmental and social impacts while maintaining investment viability, however, this decision-making will occur within the approved Development Corridor, rather than at a macro scale (i.e. site identification/selection).

2.4 Project Design Principles

While wind farms, in general, can occupy a large area of land, the on-ground impacts upon that land are relatively minor by comparison to most developments. This aspect is relevant when evaluating potential impacts to land resources and biodiversity through the lens of permanent versus temporary disturbance. The vast majority of the land which is utilised for the Project will only be subject to a temporary disturbance that is returned to its previous condition at the end of construction and then, for the balance of the land, at the end of the operational life of the Project.

2.5 Agricultural Use

Post construction (i.e. during the operational phase), it is proposed that the balance of land would continue to be used for agricultural purposes such as sheep and cattle grazing, with grasses sown for ground cover and grazing fodder in disturbed areas, resulting in only a minor net change to the existing land-use.

2.6 Site Selection

The proposed Project Site was selected due to its suitability for a wind farm and the limited environmental and social constraints identified. In designing and assessing the potential impacts of the Project, the following design hierarchy was adopted:

- **Avoid** – in the first instance, all efforts were made to avoid potential environmental impacts;
- **Minimise** – where potential impacts could not be avoided, design principles sought to minimise environmental impacts, as far as feasibly possible;

- **Mitigate** – mitigation strategies will be implemented to manage the extent and severity of remaining environmental impacts; and
- **Offset** – environmental offsets shall be used only as applicable, following all efforts to first avoid, minimise and mitigate environmental impacts.

In addition, the following specific principles were adopted:

- **Minimise vegetation clearing** – areas of high conservation value and/or native vegetation were strategically avoided;
- **Minimise land disturbance** – design footprints for WTG hardstands, the ESF, Operation and Maintenance (O&M) compounds, Substations and Ancillary Infrastructure were limited to the minimum area required;
- **Protect functional riparian zones** – higher order (as per Strahler stream ordering) and higher value functional riparian zones were excluded from the developable area;
- **Use previously disturbed land** – as much as possible the Project was located on land previously modified by agricultural development;
- **Protect cultural heritage values** – through the identification and evaluation of cultural heritage assets at the Project Site;
- **Protect agricultural values** – existing agricultural values will aim to be preserved, and a negotiated lease shall offset forgone landholder income while diversifying income streams for the duration of the project life;
- **Minimise direct and indirect impacts** – as far as practicable, infrastructure was located away from nearby residences and adjoining properties; and
- **Adopt a flexible approach to design** – the final project design has responded to identified environmental impacts and constraints.

2.7 Design Evolution and Impact Minimisation through Project Adaptation

The Project has undertaken significant impact minimisation steps to reduce impacts raised during consultation.

The Proponent has been proactive in responding to community feedback. The Project design has changed extensively in response to community concerns, environmental investigations, market dynamics and WTG technological advancement. Section 6 outlines the steps that have been taken to address stakeholder issues and mitigate impacts.

In 2011 the Project layout consisted of approximately 330 WTGs. In 2013 the draft Environmental Assessment (EA) refined the Project to 249 WTGs, avoiding highly sensitive areas and reducing visual impacts. After many years of community consultation and a detailed review of the transmission network, the Project was significantly revised in July 2018 removing 122 WTGs from the eastern half of the Project, leaving 127 WTGs proposed. Ongoing consultation has further refined the Project to 97 WTGs, giving consideration to visual amenity, noise, biodiversity, heritage, traffic and transport and communications impacts. The result is a carefully considered wind farm design which capitalizes on the reliable wind resources of the district but is sympathetic to the regions aesthetics and rural lifestyle.

Figure 2-1 to Figure 2-7 below outline the Project layout changes in response to community feedback and how the Project design has changed over time. Consultation and iterative design continue, and further changes to the Project layout are expected to occur.

It is expected that some further adjustment of the WTG locations will occur in response to stakeholder consultation and during detailed design, although all further adjustment shall be within the Development Corridor.

From the outset, the Project has adopted a methodology to, in the first instance, avoid possible environmental impacts. This design ethic is central to the current proposal and has been adopted at all stages of design. The evolution of the Project layout over time is shown in Figure 2-1 to Figure 2-7 and summarised in Table 2-1 below.

Table 2-1: Project Site and Development Footprint evolution

Timeline	Design Iteration	Mitigation
March 2011	Preliminary Environmental Assessment (PEA) investigation area.	Site refined through the PEA process and resource assessment.
February 2012	Up to 330 WTGs under consideration.	Investigation area is refined avoiding highly sensitive areas and reducing visual impacts.
April 2013	249 WTG sites under investigation.	81 WTGs removed.
May 2013	Draft EA prepared and submitted for Adequacy.	Project design refined to include access tracks, electrical layout and other infrastructure areas.
July 2018	Eastern half of project infrastructure removed leaving 127 WTGs proposed.	122 WTGs and project infrastructure were removed from eastern half of project. Reasons for decision: • extensive consultation with local community; • increase in subdivisions; and • review of the capacity in the grid network.
September 2018	• Two WTGs removed from the north west following consultation with a neighbouring landowner. • 125 WTGs remain proposed. • Locations for a large-scale battery compound added to layout. • Decision to increase proposed WTG dimensions from 200m Base to Tip Height (BTH) to 250m BTH.	Two WTGs removed following consultation with a neighbouring landowner.
October 2018	• 125 WTGs proposed. • Visual sensitivity analysis.	• Community Landscape and Visual Impact Assessment (LVIA) survey. • Discussions with neighbours continue. • Visual sensitivity analysis. • Further changes to the layout expected.
February 2019	• 125 WTGs proposed. • Investigating the potential to remove WTGs to the north east of the Project Site.	Slight changes to road design and electrical reticulation in consultation with host landowners.

Timeline	Design Iteration	Mitigation
May 2019	Decision to remove eight WTGs and ancillary infrastructure to the north east of the project leaving 117 WTGs	Infrastructure removed: • Eight WTGS • 15 km of roads • 23 km of cables • 6 ha substation / switching station • 6 ha infrastructure areas
September 2019	• 109 WTGs proposed. • Project design reviewed in consultation with landowners and WTG locations optimized.	Commitment to concentrated traffic haulage route and avoidance of minor roads (with exceptions).
February 2020	97 WTGs proposed	Reduction of impacts to residents in near the eastern end of the Project following consultation.

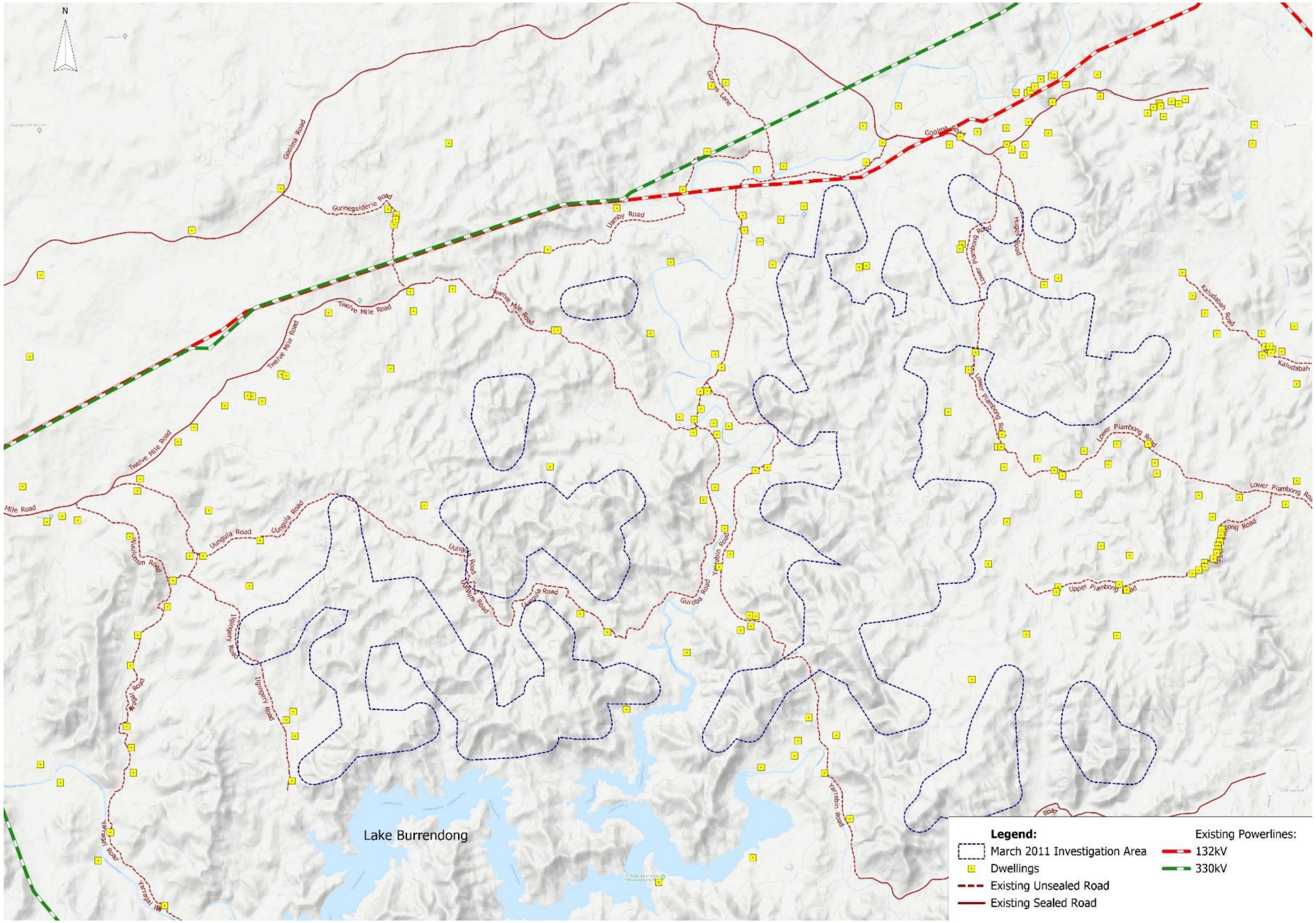


Figure 2-1: March 2011 – Preliminary Environmental Assessment investigation area

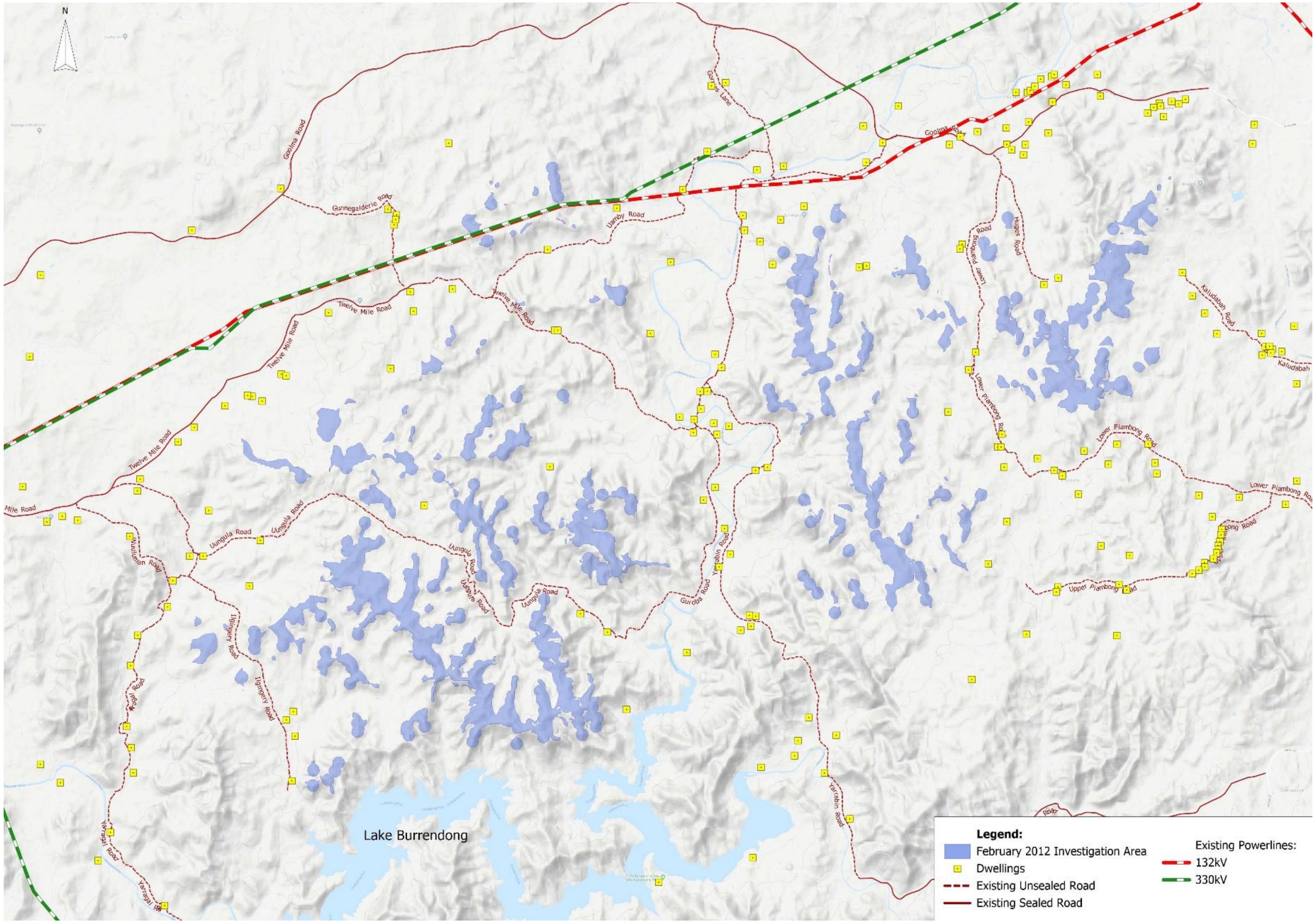


Figure 2-2: February 2012 – Investigation area is refined

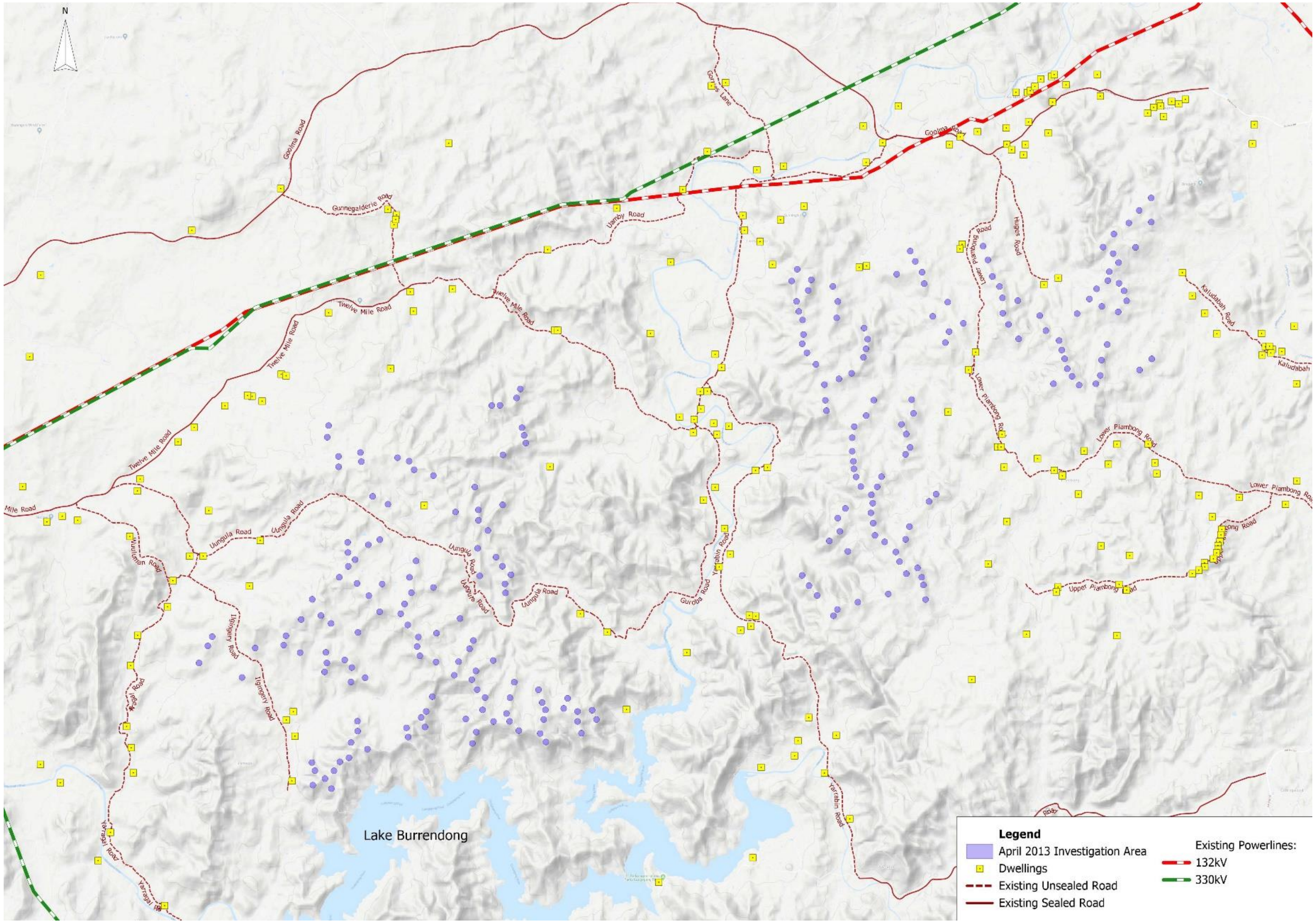


Figure 2-3: April 2013 – 249 WTG sites under investigation

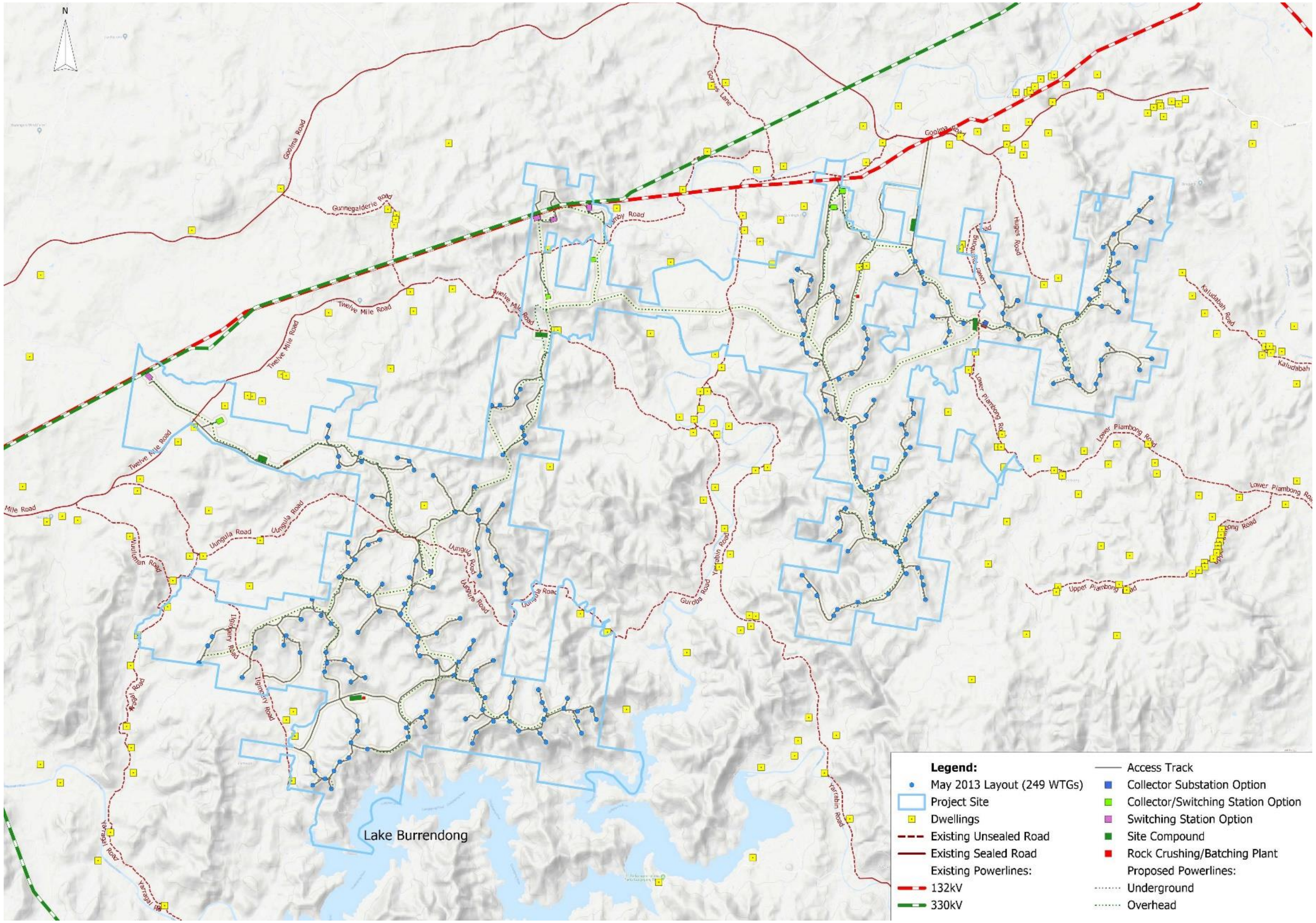


Figure 2-4: May 2013 – Project design refined to include access tracks, electrical layout and other infrastructure area

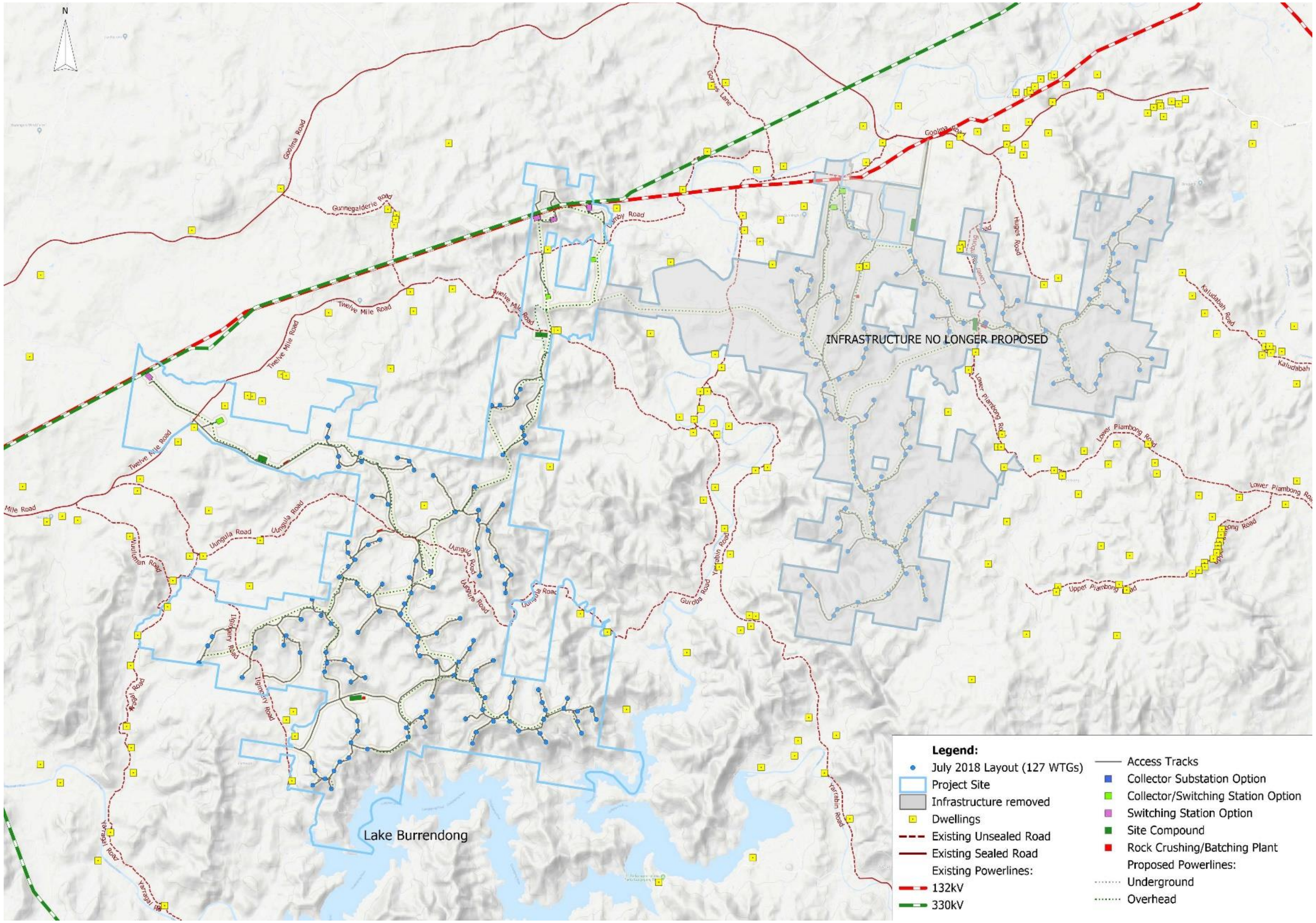


Figure 2-5: July 2018 – Eastern half of project infrastructure removed

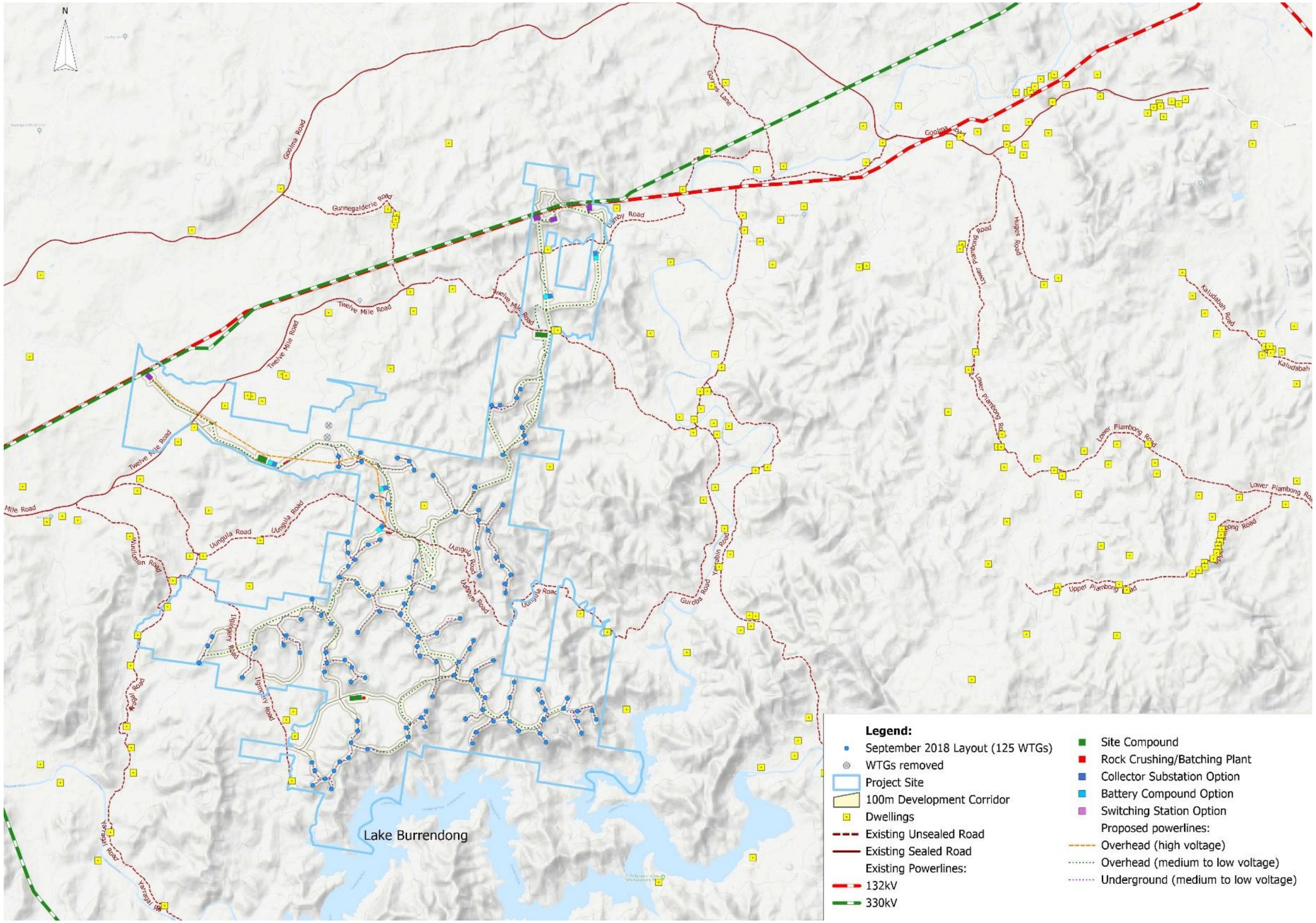


Figure 2-6: September 2018 – two WTGs removed; 125 WTGs proposed

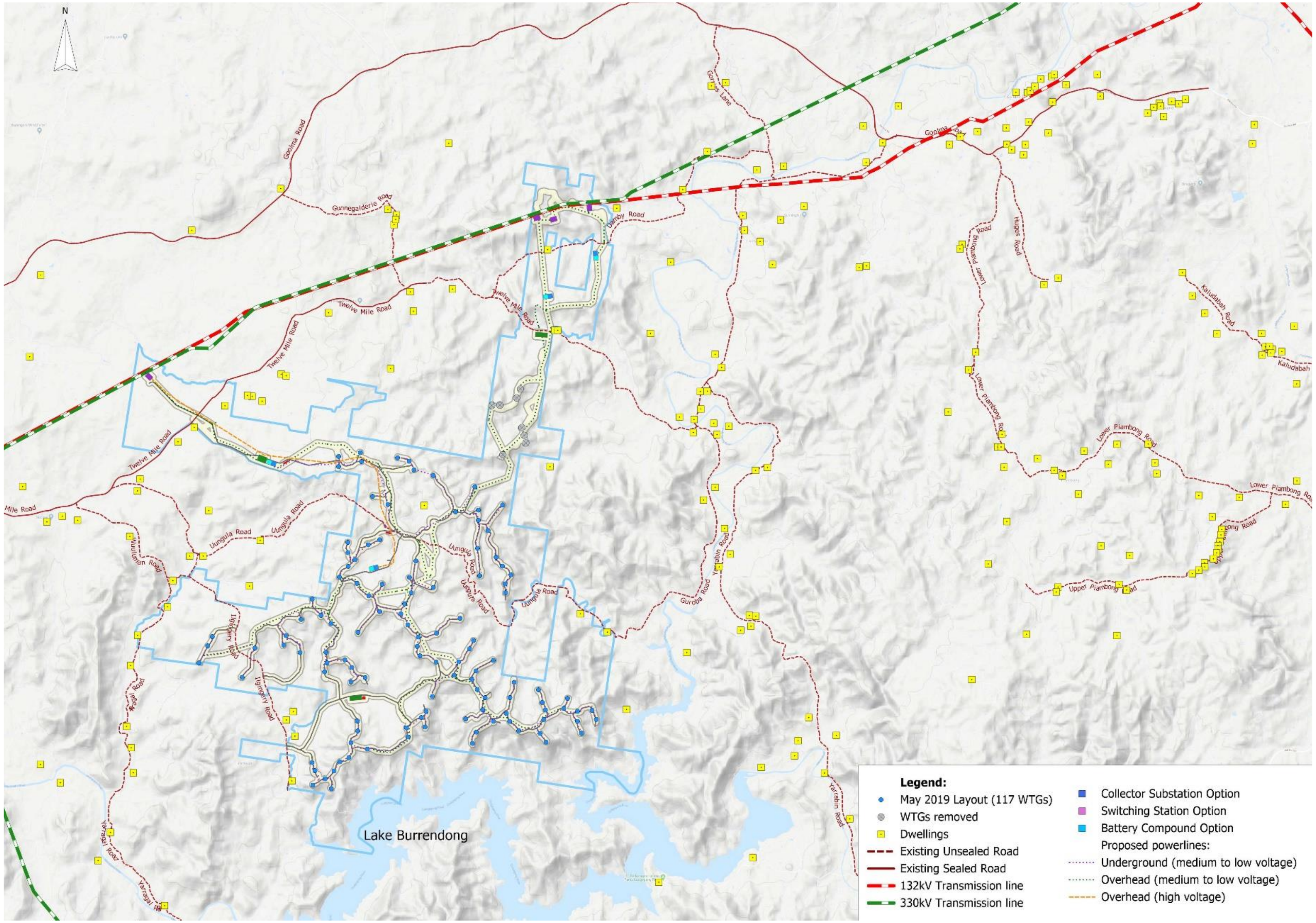


Figure 2-7: May 2019

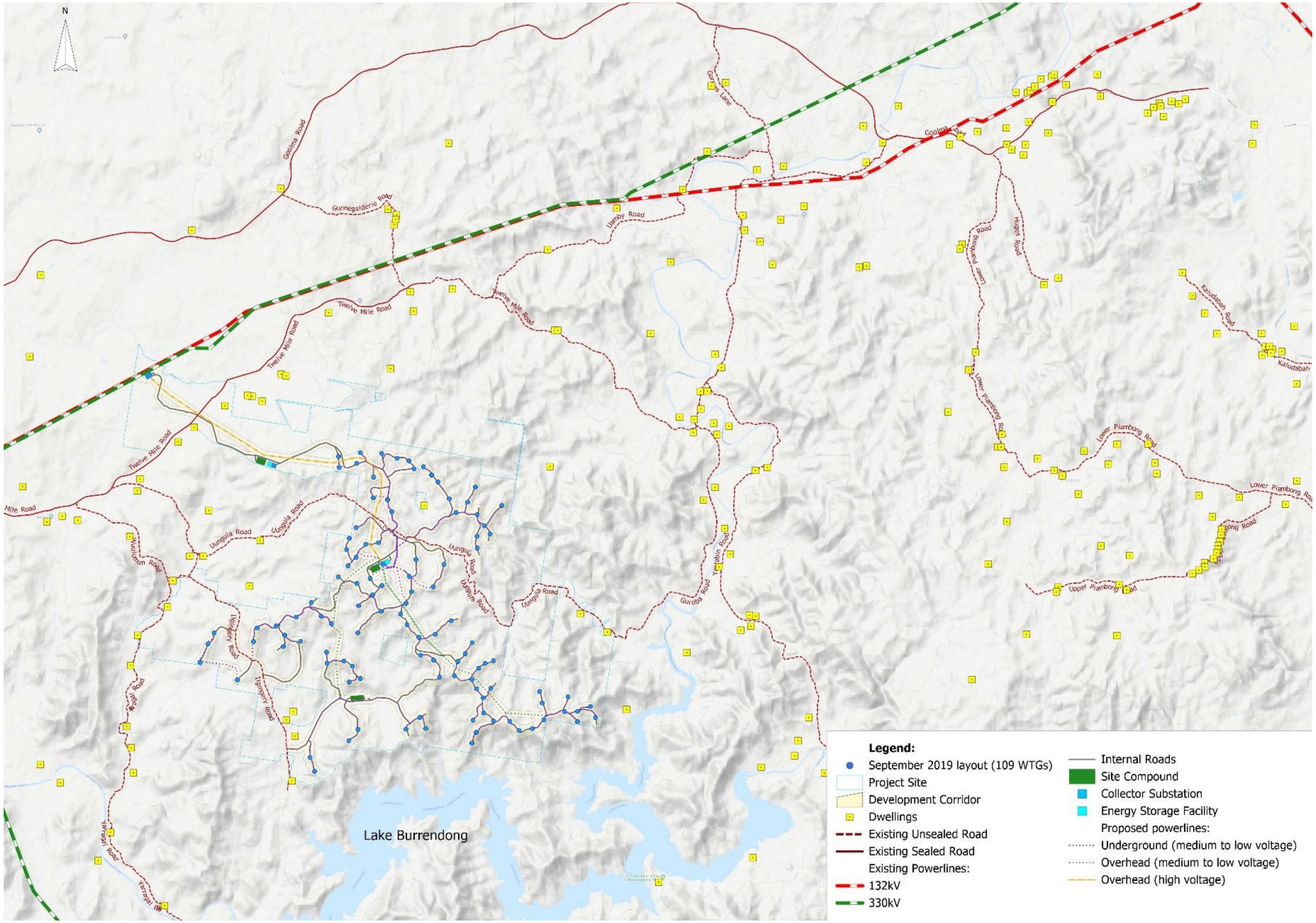


Figure 2-8: September 2019 layout (109 WTGs)

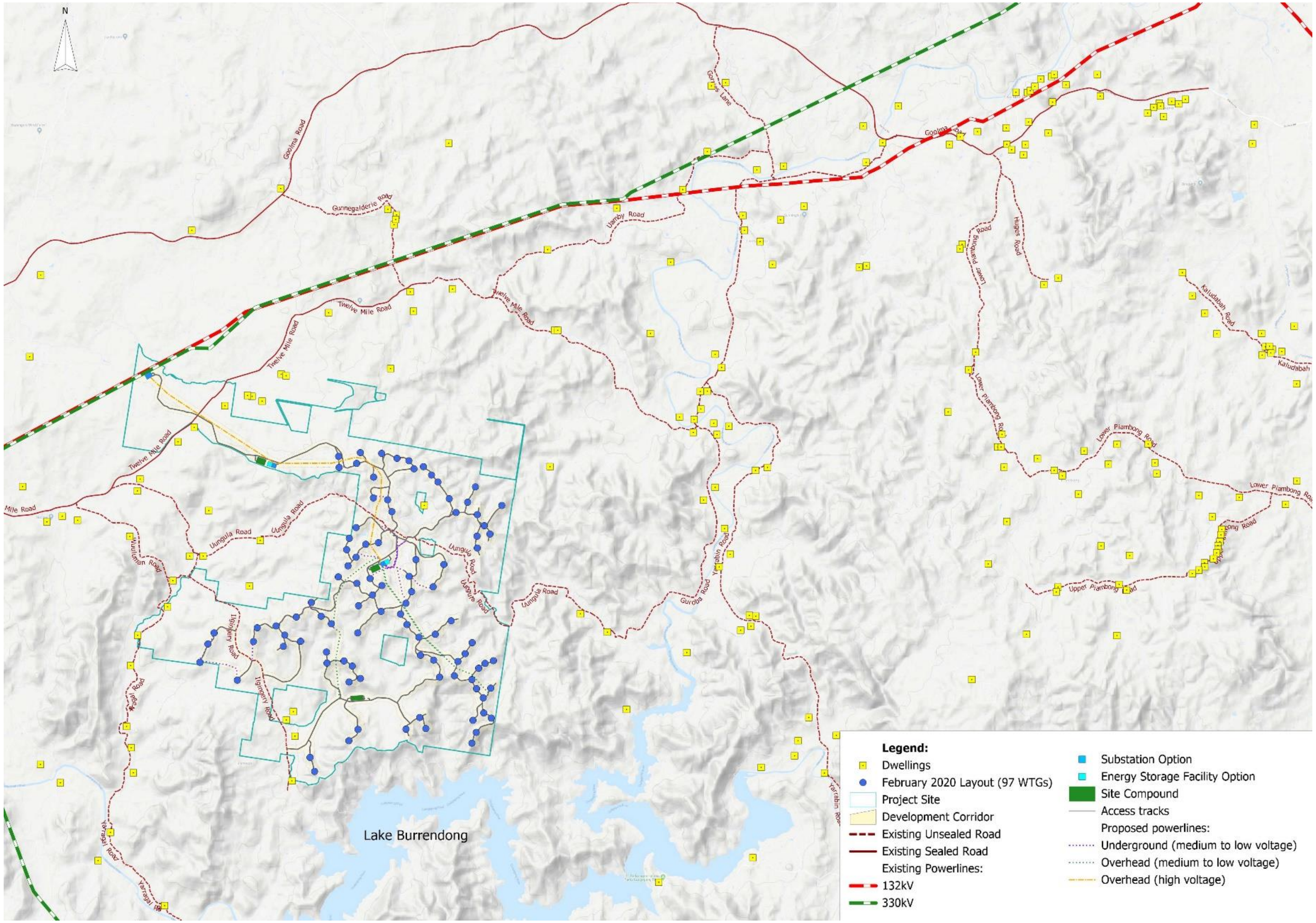


Figure 2-9: February 2020 Final Project Layout (97 WTGs)

The changes to the project design described above and shown in Table 2-1 and Figure 2-1 to Figure 2-9 have significantly reduced the potential for impacts to nearby and adjoining landholders, with a particular emphasis on minimising impacts to social amenity. Impact minimisation efforts are quantified in Table 2-2 in terms of numbers of residences the Project has avoided impacts to through undertaking design changes.

Table 2-2: Residence impact minimisation changes over time – Non-associated residences directly impacted

	No. residences with WTGs visible	No. residences requiring mitigation for visual impacts	No. residences directly adjacent to transport routes	No. residences requiring mitigation for noise impacts
2013 **249 WTG layout and 200m BTH**	191	NA	119	4
2018 **127 WTG layout and 200m BTH**	92	NA	112	NA
2018 **125 WTG layout and 250m BTH**	95	20	112	2
2019 **117 WTG layout and 250m BTH**	88	NA	112	2
2019 **109 WTG layout and 250m BTH**	89	16	13	2
2020 **97 WTG layout and 250m BTH**	84	11	13	2

Where direct impacts remain, the Proponent has sought to discuss mitigations with affected residences and establish Neighbour Agreements. The status of these agreements at the time of preparation of this EIS is shown in Table 2-3, however, these negotiations shall remain ongoing.

Table 2-3: Neighbour agreements based on impacts

	Visual			Noise			Traffic		
	Candidates	Number Offered	Number Secured (under negotiation)	Candidates	Number Offered	Number Secured (under negotiation)	Candidates	Number Offered	Number Secured (under negotiation)
Number of Residences	11	11	2(9)	2	2	2(0)	13	13	0(13)

3 Project Justification

3.1 Mandate

The social, economic and environmental benefits of developing renewable energy projects, and transitioning to a low carbon future are unequivocal, providing potential benefits to entire communities and helping to maintain quality of life. Indeed, increased adoption of renewable energy sources will assist Australia to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and carbon emissions associated with climate change (IPCC, 2018). Reduced carbon emissions have the potential to halt or slow the effects of climate change, benefitting current and future generations.

There is a growing realisation that the environmental impacts associated with the generation of energy through the use of fossil fuels requires serious and urgent mitigation. This realisation has established into international, national and state-wide commitments to support sustainable energy developments. Australia is a signatory to international agreements, conventions and protocols regarding climate change and the reduction of greenhouse gas emissions, including the 2015 Paris Agreement to reduce CO_2 emissions to 26% - 28% below 2005 levels by 2030 (DoEE, 2017). In addition, NSW has committed to an aspirational target of achieving net-zero emissions by 2050 and is following an Electricity Strategy (NSW DPIE, 2019) that recognises the importance of encouraging the deployment of renewables to help replace the States' ageing coal generators. There is a particular focus on solar and wind technologies as these are the cheapest forms of new generation and a commitment to developing REZ's through the support of transmission upgrades for a pilot 3,000 MW REZ in the Central-West region of NSW.

The Project is located within this Central-West REZ, and will therefore play an important role in meeting state, national and international commitments, addressing the need for affordable renewable energy projects to assist during the phasing out of centrally located fossil fuel generators, as well as to mitigate impacts associated with global warming and climate change.

3.1.1 Greenhouse Gas Emissions and Climate Change Science

There is global recognition of climate change and global warming due to human activities and the need to mitigate the environmental effects associated with fossil fuel energy generation. The consensus of scientific opinion as presented to world governments by the Intergovernmental Panel on Climate Change (IPCC) is that there is a link between humankind's actions and a variety of climate related issues. Industrialisation and the resultant emissions of greenhouse gases from the burning of fossil fuels have created, and continue to exacerbate, global environmental problems including climate change and global warming.

The most recent IPCC report on Global Warming (IPCC, 2018) has estimated that global surface temperatures are likely to increase by 1.5°C above pre-industrial levels between 2030 and 2052 if it the current rate of global warming is sustained. Human-induced global warming reached approximately 1°C above pre-industrial levels in 2017 (IPCC, 2018) and we are already experiencing the impacts to the climate system such as sustained drought, floods, coral bleaching, extreme weather events, biodiversity loss and sea level rise.

Fossil fuel consumption and industrial processes are the primary drivers behind the rate of carbon dioxide equivalent emissions (Figure 3-1). Central to this is a heavy reliance on coal for electricity production, which is also recognised as having the highest output of carbon dioxide equivalent emissions (Garnaut, 2008).

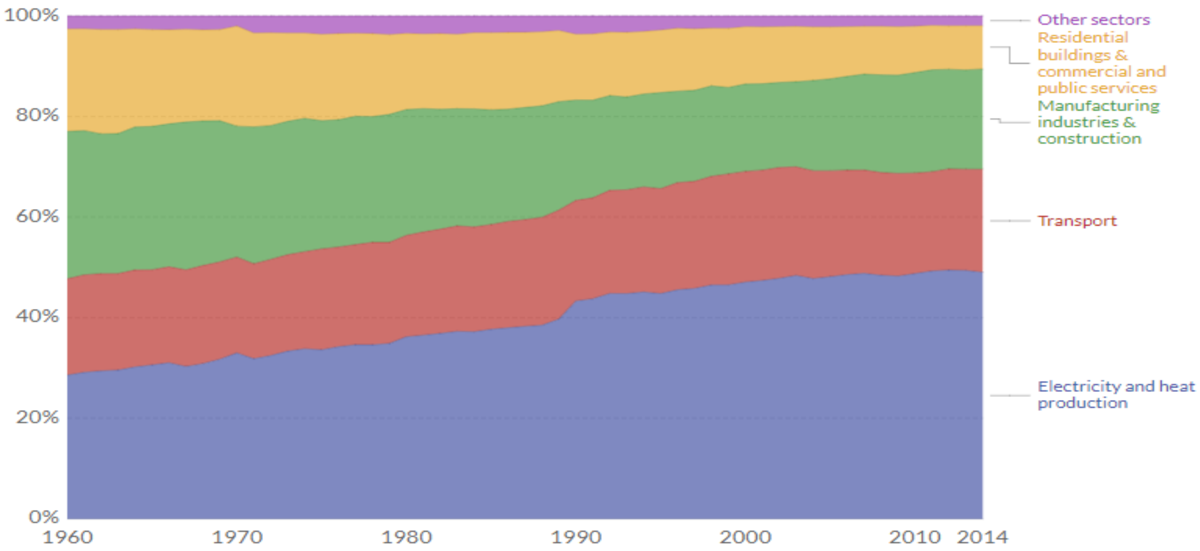


Figure 3-1: Global carbon dioxide (CO_2) emissions by sector or source (OWID, 2019)

Continued and unrestricted emission of greenhouse gases will cause further warming and long-lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystems. Limiting climate change will require substantial and sustained reductions in greenhouse gas emissions which, together with adaptation, can limit climate change risks (IPCC, 2018). The IPCC notes that there are multiple mitigation pathways that are likely to limit warming to below 1.5°C relative to pre-industrial levels. Since the energy sector is the highest emitting, reductions in this sector should be a high priority globally. The IPCC's 'Below 1.5°C mitigation pathways' include a strong increase in primary energy production from renewable sources by 2050

(52-67% supply share), improvements in energy efficiency, as well as a reduction in energy generation from coal (1-7% decrease) (IPCC, 2018).

3.2 Current Global Response – The Paris Agreement

The Paris Agreement brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

The Paris Agreement central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework is being put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives. The Agreement also provides for enhanced transparency of action and support through a more robust transparency framework.

3.2.1 United Nations Sustainable Development Goals

The United Nations 2030 Agenda for Sustainable Development includes a set of 17 interdependent global Sustainable Development Goals (SDGs) to help build a more sustainable and resilient future for all (Figure 3-2). The SDGs are broken down into 169 individual targets to stimulate and measure action towards improving economic, social and environmental sustainability. All countries of the world have agreed to work towards achieving the SDGs by 2030.

Figure 3-2: Interdependent global Sustainable Development Goals (United Nations)

The Project will respond positively to Goal 7 Affordable and Clean Energy and will contribute towards Target 7.2: ‘By 2030, increase substantially the share of renewable energy in the global energy mix’. The UN explains:

> _“Transitioning the global economy towards clean and sustainable sources of energy is one of our greatest challenges in the coming decades. Sustainable energy is an opportunity – it transforms lives, economies and the planet."_

The primary function of the Project is to generate renewable energy and increase the amount of renewable energy in Australia’s energy mix the project will improve affordability for all. The Project will also contribute towards _Goal 11 Sustainable Cities and Communities_ (Target 11.6) by helping to reduce Australia’s reliance on power from fossil fuels which will improve air quality and have positive impacts on health and wellbeing.

3.3 Australian Emissions and Response

Australia is one of the highest emitters of greenhouse gas emissions in the world at 16.5 metric tonnes of carbon dioxide equivalent per capita in 2016 (OWID, 2019) (Figure 3-3). Australia’s emissions are continuing to increase and for the year to September 2018 emissions increased by 0.9 per cent on the previous year, primarily due to increases in LNG exports and steel and aluminium production (DoEE, 2018).

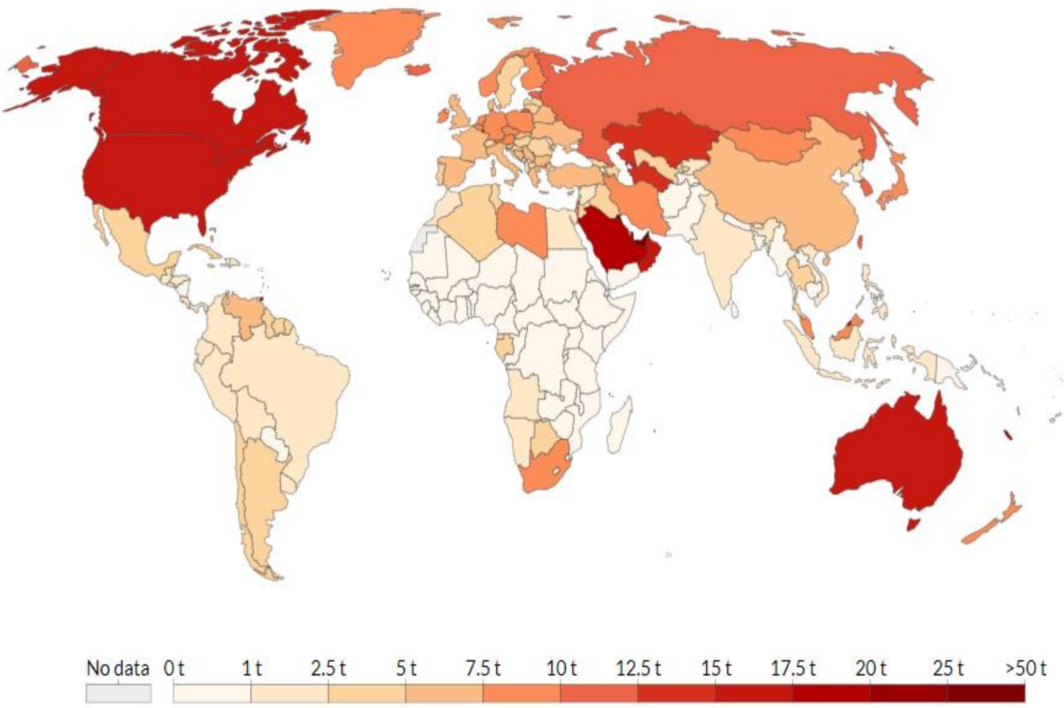


Figure 3-3: Average CO_2 emissions per capita measured in tonnes per year in 2016 (OWID, 2019)

Electricity generation is the largest source of Australia's emissions, accounting for 33.7 % of emissions in the year to September 2018 (DEE, 2018) (Figure 3-4). Emissions from electricity decreased by 3.2 % on the previous year to September 2018 (DEE, 2018). Greenhouse gas emissions from the NEM account for around 83% of national electricity emissions (DoEE, 2018).

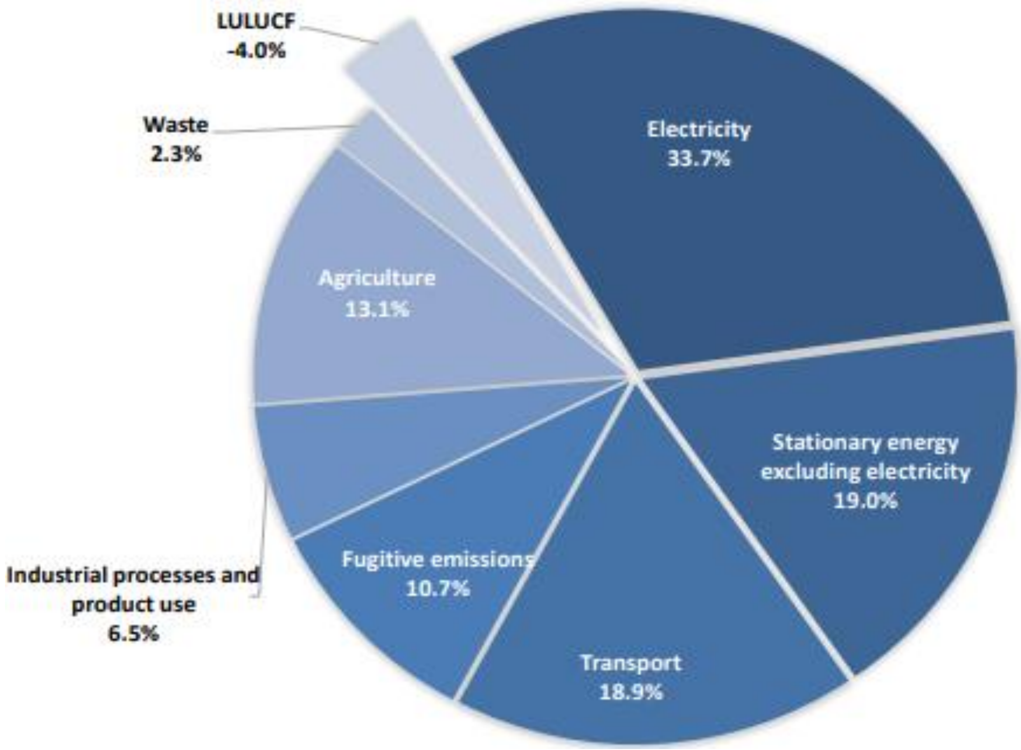


Figure 3-4: Emissions contribution by sector in Australia (DoEE, 2018)

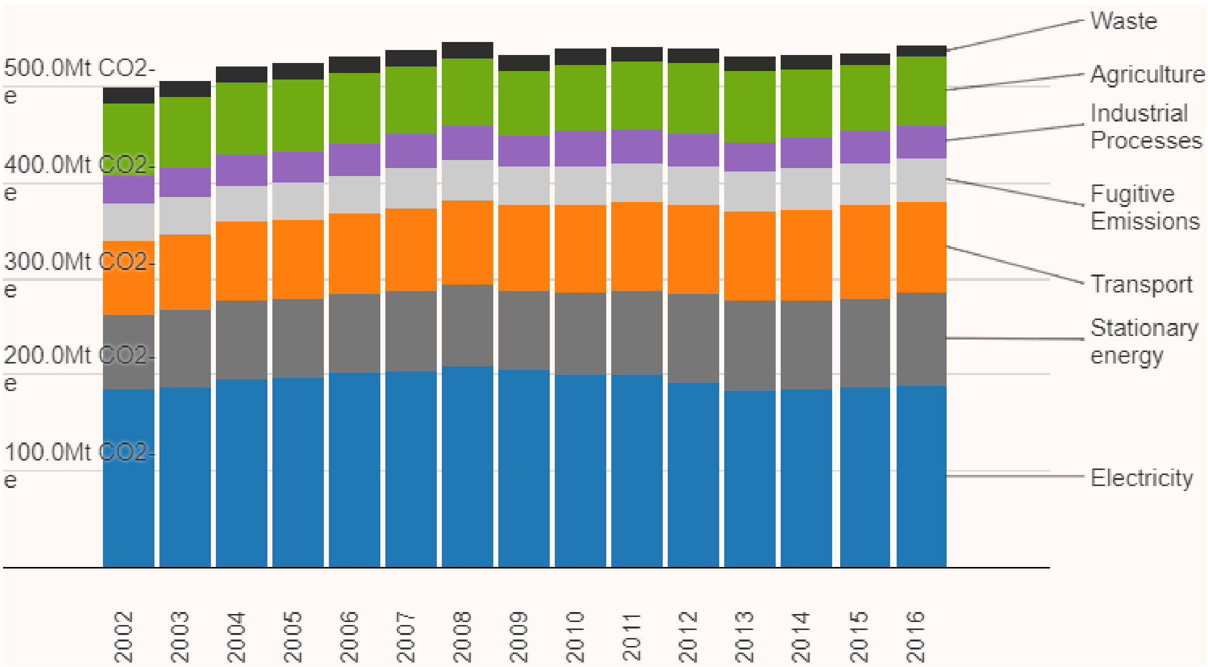


Figure 3-5: Australia's annual greenhouse gas emissions by sector

The State of the Climate 2018 report, published by Bureau of Meteorology (BoM) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO), provides the most up-to-date scientific assessment of observed Australian climate changes and causes, and projections for the 21st century. Key studies / projections include (CSIRO & BoM, 2018):

- Australia's climate has warmed by just over 1°C since 1910, leading to an increase in the frequency of extreme heat events and more frequent marine heatwaves;
- Sea levels are rising around Australia, increasing the risk of inundation;
- The oceans around Australia are acidifying (the pH is decreasing);
- April to October rainfall has decreased in the southwest of Australia. Across the same region May–July rainfall has seen the largest decrease, by around 20 per cent since 1970;
- There has been a decline of around 11 per cent in April–October rainfall in the southeast of Australia since the late 1990s;
- Rainfall has increased across parts of northern Australia since the 1970s;
- Streamflow has decreased across southern Australia. Streamflow has increased in northern Australia where rainfall has increased;
- There has been a long-term increase in extreme fire weather, and in the length of the fire season, across large parts of Australia**;**
- Australia is projected to experience:
    - Further increases in sea and air temperatures, with more hot days and marine heatwaves, and fewer cool extremes;
    - Further sea level rise and ocean acidification; and
    - Decreases in rainfall across southern Australia with more time in drought, but an increase in intense heavy rainfall throughout Australia.

These changes have significant impacts many Australians, particularly those in regional communities more susceptible to changing climate conditions. To combat these recorded and potential impacts and affirm Australia's commitments to its international agreements, the Australian government and other agencies and participants in the climate change and energy sectors have come up with several responses in the form of Acts and policies, funds, programs and schemes.

3.3.1 Australian Government ratification of the Paris Agreement

The Australian Government ratified the Paris Agreement in November 2016, committing to an unconditional Nationally Determined Contribution (NDC) to reduce emissions by 26-28% below 2005 levels by 2030, which builds on the Cancun Pledge target of reducing emissions by 5% below 2000 levels by 2020.

Australia is on track to overachieve its Cancun pledge 2020 target by 166 $MtCO_2e$ (without the Kyoto Protocol carbon budget carry-over). However, under current policy, Australia is not on track to achieve its 2030 NDC target, with emissions levels projected to be well above the target by 2030 due to lack of climate policy (UNEP, 2018).

3.3.2 Australian Government Energy Policies / Funding

Australia's response to climate change and energy policies were at the forefront of the most-recent 2019 Australian Federal election campaign.

On 25 February 2019, the Australian Government announced the Climate Solutions Package, a $3.5 billion investment to deliver on Australia's 2030 Paris climate commitments. The Climate Solutions Package aims to provide the following (Department of Agriculture, Water and the Environment, 2019):

- A $2 billion Climate Solutions Fund to reduce greenhouse gases across the economy through the existing Emissions Reduction Fund;
- Investments in high-tech expansion projects such as the Snowy Mountains Scheme and a second interconnector and the Marinus Link, between Victoria and Tasmania; and
- The development of a National Electric Vehicle Strategy.

3.4 NSW Government Emissions and Response

Although NSW does not have a specific renewable energy target, the state government has set a long-term target for NSW to have zero net emissions by 2050, including in its energy sector.

Ten of Australia's coal power stations in the NEM have closed since 2012. The majority of Australia's remaining coal power stations are aging, becoming unreliable, inefficient and costly. Of the 21 coal fired power stations currently operating in Australia, by 2030 three are set to close and six will be within five years of their total life (CEC, 2018). Extending the life of old coal power stations is extremely expensive and building a new coal power station is the most expensive form of new power generation.

In early 2019, a court ruling by the NSW Land and Environment Court rejected a new coal mine planned near the town of Gloucester on the NSW mid-north coast. Furthermore, in September 2019, the Independent Planning Commission (IPC) refused development consent for the Bylong Coal Project for numerous reasons, with the main being failure to address Scope 3 Greenhouse Gas emissions and the project being contrary to the principles of ESD, specifically the principle of intergenerational equity, in that the predicted economic benefits would accrue to the present generation but the long-term environmental, heritage and agricultural costs would be borne by the future generations, therefore, not being in the public interest. These landmark court rulings, primarily based on social and environmental risks including the impact of greenhouse gas emissions at a global scale, affirms the widespread view to transition away from coal.

3.4.1 NSW Net Zero Plan Stage 1: 2020 – 2030

The Net Zero Plan Stage 1: 2020-2030 is the foundation for NSW's action on climate change and goal to reach net zero emissions by 2050. It outlines the NSW Government's plan to grow the economy, create jobs and reduce emissions over the next decade.

The plan aims to enhance the prosperity and quality of life of the people of NSW, while helping the state to deliver a 35% cut in emissions by 2030 compared to 2005 levels (Figure 3 6). Currently the majority of emissions in NSW are derived from electricity generation (Figure 3 7). The plan will support a range of initiatives targeting electricity and energy efficiency, electric vehicles, hydrogen, primary industries, coal innovation, organic waste and carbon financing.

The implementation of the Net Zero Plan, together with the NSW Electricity Strategy, will result in more than $11.6 billion of new investment for NSW, including $7 billion in regional NSW. This will support the creation of almost 2400 new jobs, including 1700 jobs located in the regions.

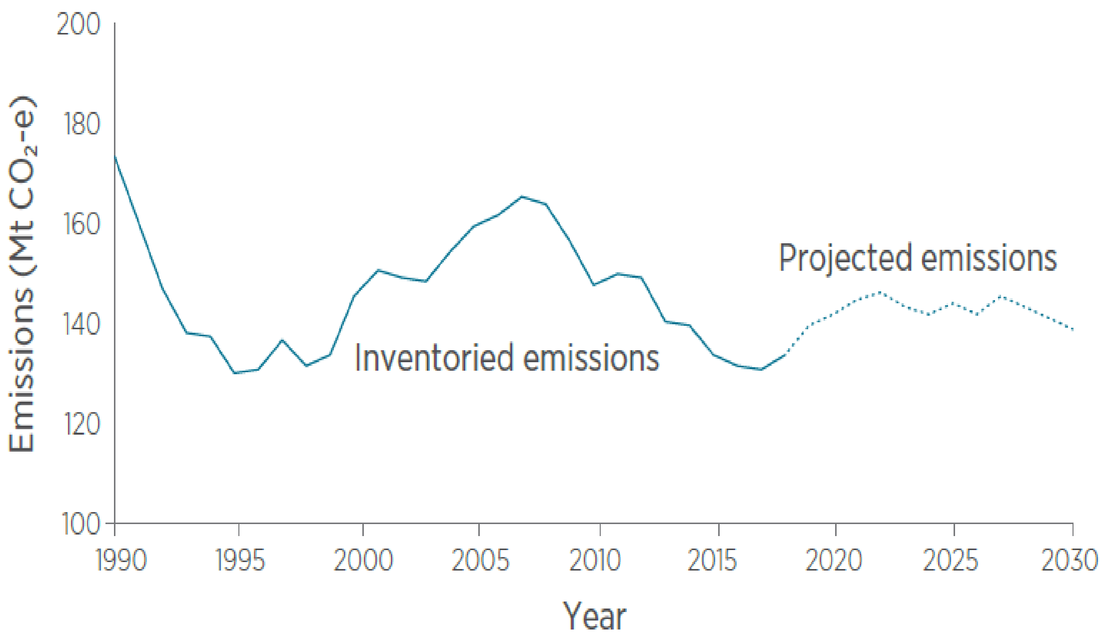


Figure 3-6: NSW total annual emissions to 2030 (DPIE, 2020). Note MtCO2-e = Megatonnes of carbon dioxide equivalent

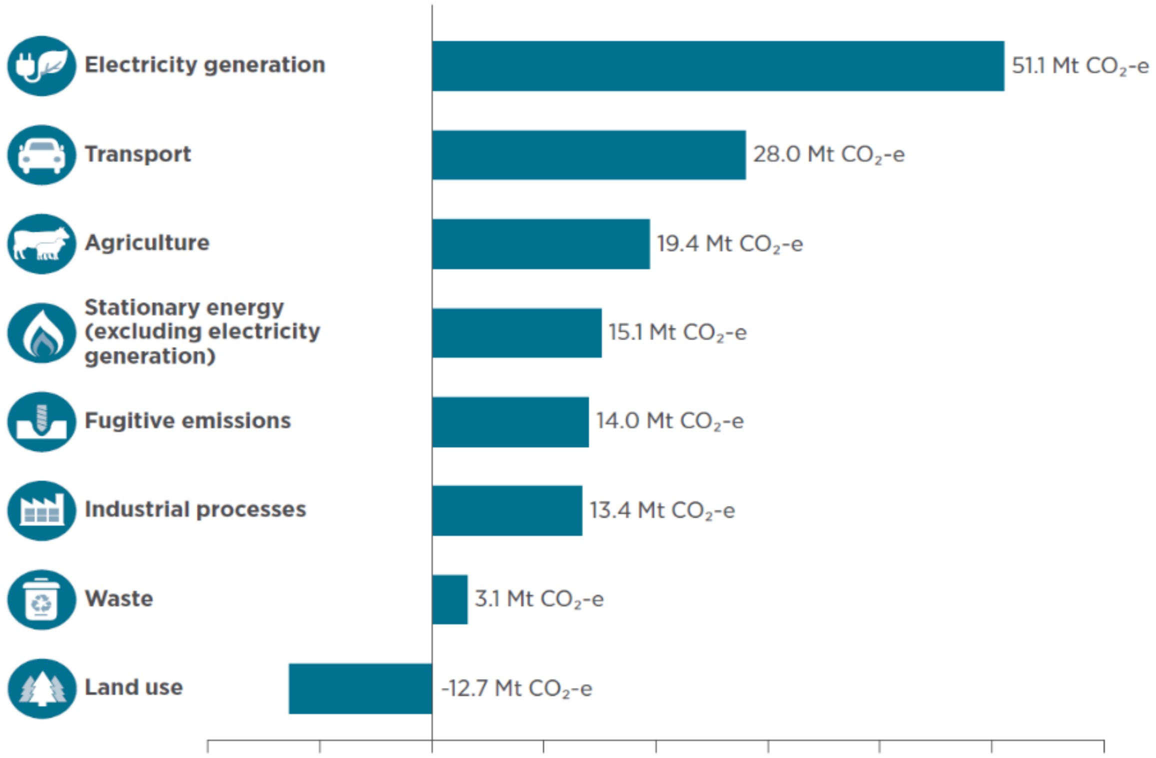


Figure 3-7: NSW emissions by sector in 2017 (DPIE, 2020)

3.4.2 NSW Electricity Strategy

The NSW Electricity Strategy is the NSW Government's plan for a reliable, affordable and sustainable electricity future that supports a growing economy. The strategy encourages an estimated $8 billion of new private investment in NSW's electricity system over the next decade, including $5.6 billion in regional NSW. It will also support an estimated 1,200 jobs, mostly in regional NSW. The strategy aligns closely with the NSW Government's Net Zero Plan Stage 1: 2020 – 2030.

Significantly for the Project, the strategy supports the development of new transmission infrastructure to connect low-cost generation to the electricity system by developing REZ's, including the pilot REZ for the state in the Central-West region. This pilot REZ will see the Government support network upgrades to encourage the connection of 3,000 MW of new renewable energy capacity into the network. The project is located squarely within the Central-West REZ and would account for greater than 10% of this target capacity.

3.4.2.1 Renewable Energy Zones and Central-West Renewable Energy Zone Pilot

The NSW Government's Electricity Strategy sets out a plan to deliver three REZs in the State's Central-West, New England and South-West regions to aid in unlocking a significant amount of large-scale renewable energy and storage projects.

The NSW Government is in the early stages of feasibility and planning for the state's first pilot REZ, which is set to be built in the Central-West, in which the Project is located (Figure 3-8). This REZ will play a vital role in delivering affordable energy to help replace the state's existing power stations as they retire over the coming decades. In particular, the Central-West REZ pilot will:

- unlock up to 3,000 MW of new generation by the mid-2020s;
- be worth around $4.4 billion in private sector investment once fully developed;
- provide enough generation capacity to power approximately 1.3 million homes; and
- support 450 construction jobs within the local region.

The Central-West region is the planned location for the first pilot REZ due to existing investment and interest, with around 4,500 MW of projects either approved or in the planning system.

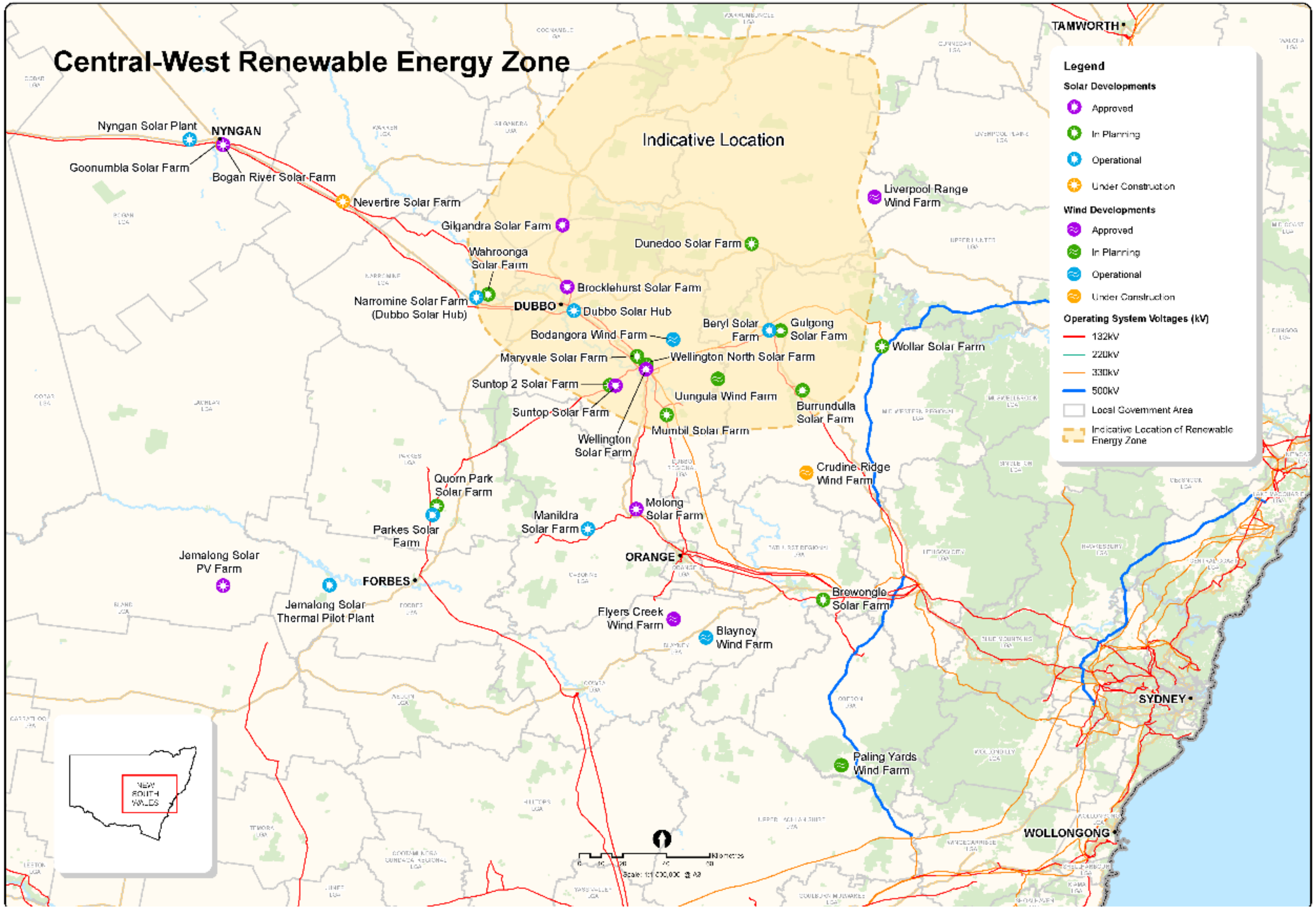


Figure 3-8: Location of central-west renewable energy zone

3.4.3 Central West and Orana Regional Plan

The Central West and Orana Regional Plan 2036 is a 20-year blueprint for the future of the Central West and Orana region. The Plan seeks to create a leading diverse regional economy in NSW, with a vibrant network of centres leveraging the opportunities of being at the heart of NSW. The 'vision' of the Regional Plan seeks, in part, to promote landmark solar, wind and bioenergy projects and distinguish the region as a leader in renewable energy development.

The Plan identifies the Central West area has significant potential for renewable energy industries with vast open spaces and higher altitude tablelands. Areas in the Central West, including Blayney, Oberon and Wellington, are suitable for wind farms and TransGrid's NSW Connection Opportunities identifies Parkes and Wellington as having capacity for renewable energy generation. Under the Plan, it is identified new renewable energy projects require a strategic approach and should, where possible, incorporate small-scale co-generation measures into their design. Early and effective community engagement will be promoted on these projects.

The Project, which seeks consent for a wind farm using modern renewable energy technology, complies with the actions of Direction 9 of the Central West and Orana Regional Plan which seek to:

- Identify locations with renewable energy generation potential and access to the electricity network;
- Facilitate small-scale renewable energy projects using bioenergy, solar, wind, small-scale hydro, geothermal or innovative storage technologies through local environmental plans; and
- Promote best practice community engagement and maximise community benefits from all utility-scale renewable energy projects.

3.4.4 NSW Wind Energy Guidelines for SSD

The NSW Wind Energy Guidelines for SSD (DPE, 2016a) seek to provide general guidance and regulation on the planning framework for the assessment and determination of large-scale SSD wind energy projects within NSW.

The objectives of the Wind Energy Guidelines (DPE, 2016a) are to: -

(a) provide clear and consistent guidance to the community, industry and regulators about how to measure and assess key environmental impacts of SSD wind energy development in NSW;

(b) facilitate better outcomes by requiring early identification of impacts to drive better siting and design;

(c) *facilitate meaningful, respectful and effective community and stakeholder engagement across the development assessment process, from pre-lodgement to post-approval;*

(d) *encourage benefit-sharing between wind energy operators and the communities in which they operate, where appropriate; and*

(e) *provide greater accountability for the management of impacts over the life of a project by linking commitments to conditions and / or appropriate monitoring and adaptive management strategies.*

The Project has been developed in accordance with the typical assessment and approval processes of SSD. The Guidelines which have been developed by Department of Planning and Environment (DPE), specifically for large scale wind energy projects, outline the environmental issues relevant to wind energy developments that must be considered in the environmental assessment. These issues have subsequently been included in the SEARs, dated 11 November 2019, and include strategic context (compliance with climate change policies and Renewable Energy Targets), visual and landscape, noise and vibration, biodiversity, traffic and transport, hazards and risk, heritage, water and soils, waste and socio-economic impacts, decommissioning and cumulative impacts.

The Guidelines have been an integral component in the development of the Project and each of the environmental assessment requirements are addressed by the Proponent. The Project complies with and is consistent with the requirements of the Guidelines to ensure coherence with the SEARs as well as other relevant Plans and Policies pertaining to large scale wind farm developments.

3.5 Validation

The Project responds to the global mandate, harnessing the renewable energy of wind resources to provide a clean, safe, reliable and affordable energy source while adhering to the principles of ESD.

3.5.1 Ecologically Sustainable Development

The Commonwealth of Australia (1992) defines ESD as:

> "*using, conserving and enhancing the community's resources so that the ecological processes, on which life depends, are maintained and the total quality of life, now and in the future, can be increased*".

ESD integrates social, economic and environmental considerations into the decision-making process. The principle basis for ESD is that current and future generations should leave a natural environment that functions as well, or better, than the one inherited. The EP&A Regulation identifies four key principles to assist in the achievement of ESD, these are:

- The precautionary principle;
- Inter-generational equity;
- Conservation of biological diversity and ecological integrity; and
- Improved valuation and pricing incentive mechanisms.

Each of the principles of ESD with respect to the Project and its environmental impact assessment are considered in the following subsections.

3.5.1.1 Precautionary Principle

As defined within the EP&A Regulation, the Precautionary Principle states that:

If there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.

The potential for environmental impact has been considered throughout the design and development of the Project. The potential impacts identified through the SEARs and Environmental Risk Assessment (Section 7) have been assessed as accurately as possible, using appropriate specialists in relevant disciplines where required. The assessment process involved computer modelling, scientific research, analysis and interpretation of the potential environmental impacts associated with the Project during the construction, operational and decommissioning phases.

This process has enabled the impacts of the Project to be predicted with a reasonable degree of certainty. All predictions, however, contain a degree of variability and uncertainty, which reflects the nature of the environment. Where there has been any uncertainty in the prediction of impacts throughout the EIS process, a conservative approach was adopted to ensure the worst-case scenario was predicted in the assessment of impacts.

The Project is consistent with the precautionary principle in that where there was uncertainty, conservative overestimates where used, examples include:

- The LVIA was based on the blade tip of each WTG being 250 m and solely based on topographic information. For this reason, impacts will potentially be considerably less than the worst-case scenario which has been assessed;

- The Noise and Vibration Assessment utilised the WTG model with the highest sound power level, being the *Vestas V162-5.6MW*, and made the assumption that all construction equipment would operate simultaneously on site for each stage of construction;
- Potential impacts were assessed assuming the use of a larger infrastructure footprint and more WTG locations than will ultimately be constructed;
- Where potential threats to the environment have been identified, the Proponent has altered the project design for avoidance or mitigation; and
- Monitoring will be undertaken, as a precautionary measure to reduce the effect of any uncertainty regarding the potential for environmental damage.

3.5.1.2 Inter-Generational Equity

As defined within the EP&A Regulation, the principle of inter-generational equity states that:

The present generation should ensure that the health, diversity and productivity of the environment are maintained or enhanced for the benefit of future generations.

Social equity involves value concepts of justice and fairness, so that the basic needs of all sectors of society are met and there is a fair distribution of costs and benefits to improve the well-being and welfare of the community, population and society. Social equity includes inter-generational equity, which requires that the present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.

The objective of the Project is to provide a source of renewable electricity that is safe and non-polluting, which can be utilised by the community and help to reduce dependency on greenhouse gases. As such, the Project wholly fits in line with this principle as it has been deemed a necessary step in decreasing societal reliance on carbon-based energy sources. In turn, the addition of a new wind farm, which may result from the Project, will reduce overall greenhouse gas emissions and human contribution towards climate change, which stands to have a major impact on future generations.

Increased adoption of renewable energy sources will assist Australia to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and carbon emissions associated with climate change. Reduced carbon emissions have the potential to slow the effects of climate change, benefitting current and future generations.

Electricity generated from the Project would provide a clean electricity source for local and regional consumers in a cost-effective manner, providing improved opportunities and quality of life for all members of the regional community.

3.5.1.3 Conservation of Biological Diversity and Maintenance of Ecological Integrity

As defined within the EP&A Regulation, the principle of conservation of biological diversity and ecological integrity states that:

Conservation of biological diversity and ecological integrity should be a fundamental consideration.

Biological diversity refers to the diversity of genes, species, populations, communities and ecosystems, and the linkages between them. Maintaining biological diversity safeguards life support functions and can be considered a minimal requirement for intergenerational equity.

The conservation of biological diversity and ecological integrity has been considered and integrated at all stages of the Project. The proposed Project has been assessed for its biological and ecological impacts which are discussed in detail in Section 8.4. Areas of higher conservation value have been avoided during the evolution of the Project Design where possible, and where identified impacts are unavoidable these will be managed by the implementation of mitigation measures, including both ecosystem and species credits. At the conclusion of the 30-year development approval, the Project equipment will either be replaced, or the Project shall be fully decommissioned, and the site rehabilitated.

As discussed in Section 4.1.9.2, the Proponent will prepare a Biodiversity Management Plan (BMP) and EMS prior to the Project being constructed, operated and decommissioned.

3.5.1.4 Improved Valuation and Pricing of Environmental Resources

As defined within the EP&A Regulation, the principle of improved valuation and pricing of environmental resources states that:

that environmental factors should be included in the valuation of assets and services, such as—

(i) polluter pays, that is, those who generate pollution and waste should bear the cost of containment, avoidance or abatement,

(ii) the users of goods and services should pay prices based on the full life cycle of costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste,

(iii) environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, that enable those best placed

to maximise benefits or minimise costs to develop their own solutions and responses to environmental problems.

The environment has conventionally been considered a free resource, with the true cost to the environment not factored into cost of production or use of the resource. This principle involves placing a monetary or social value on the environment that ultimately increases its value in order to decrease future exploitation.

The Project recognises and makes use of the inherent value in wind energy. This converts an abundant, renewable natural resource (wind) into a valuable and valued commodity (electricity).

The commitment to offset impacts to native vegetation and to fund future biological conservation activities through the Framework for Biodiversity Assessment (FBA) recognises and places an appropriate monetary value on environmental protection and the maintenance of biodiversity.

3.5.2 Suitability of Wind Power

The ability to harness wind power has evolved significantly in the last 30 years into an efficient, competitive and mainstream energy supply technology. At the end of 2018, the overall capacity of all WTGs installed globally reached almost 600 Gigawatt, supplying approximately 6% of the global demand for electricity (WWEA, 2019) (Figure 3-9). Wind energy generation's current share of the total Australian primary energy consumption is currently 4.9% (DoEE, 2018).

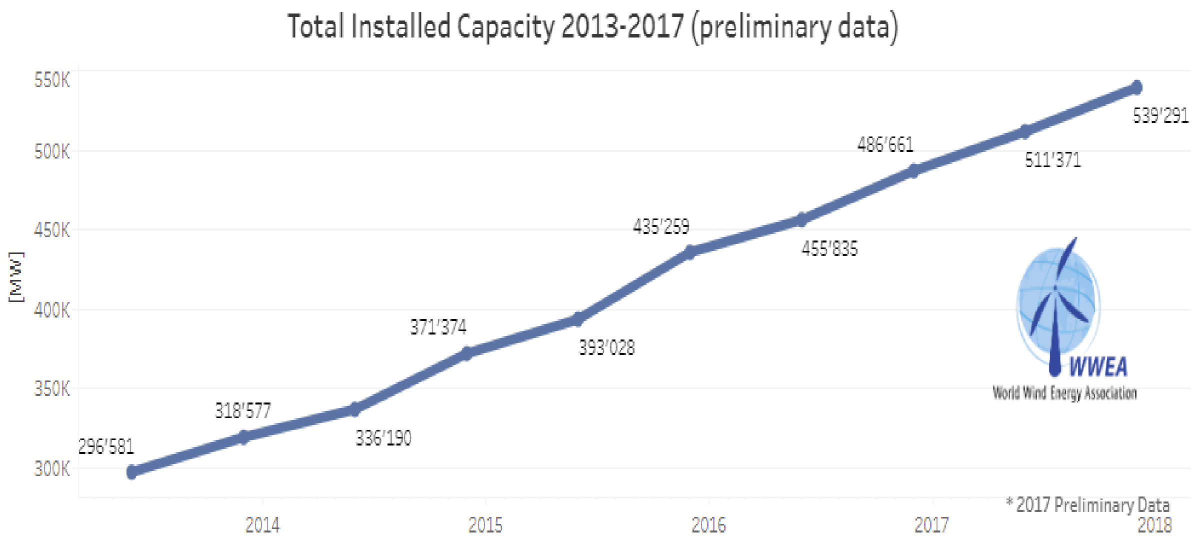


Figure 3-9: Total installed WTG capacity between 2013-2017 (MW)

Wind energy is well positioned to meet future targets and global demand for electricity, as it possesses one of the lowest production costs, uses no water during electricity production and is a mature technology acceptable to energy utilities in comparison to other renewable energy sources.

3.5.2.1 Cost of energy

Wind power is currently the cheapest form of new-build electricity available in the market. The cost of wind generation technology has fallen dramatically over the past decade and is increasingly competitive against traditional fossil-fuel based energy sources (IRENA, 2018). In addition, reductions in the costs of battery storage is improving the competitiveness of renewable projects previously limited by reliability constraints (CSIRO, 2017).

A common metric used to directly compare energy generation technologies is calculating their levelized cost of energy (LCOE) which includes the capital costs, operating costs and maintenance costs associated with the project. The global weighted average LCOE of wind energy generation fell by 23% between 2010 and 2017, driven mainly by the reduction in WTG costs and improvements in wind generation technology efficiency to allow more electricity to be harvested at lower wind sites (IRENA 2018).

The GenCost 2018 report, a collaboration between CSIRO and Australian Energy Market Operator (AEMO), provides a transparent and coordinated approach to updating Australia's electricity generation costs annually. The report indicates that the LCOE of wind generation is continuing to fall as larger, more efficient WTGs enter the Australian market. Figure 3-10 below shows the LCOE for a range of generation technologies including standalone generation and 'firmed' wind energy including two storage options, battery and pumped hydro energy storage.

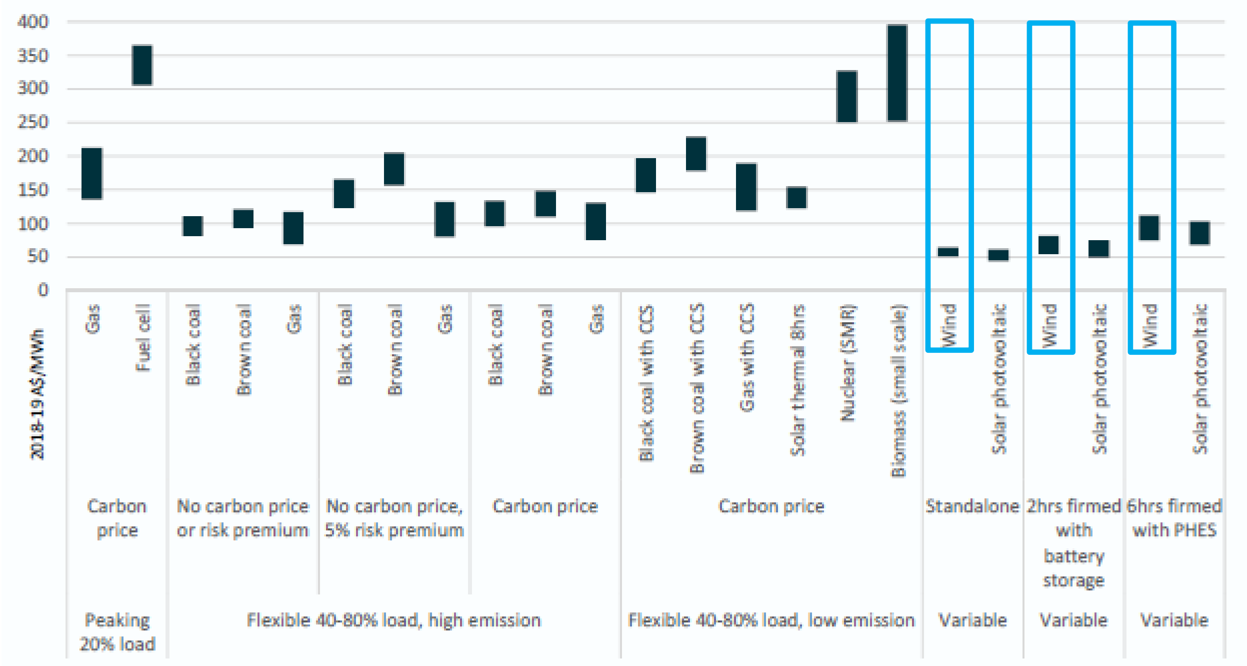


Figure 3-10: Calculated LCOE by technology and category for 2020 (GenCost, 2018)

3.5.2.2 Reliability of Wind Power

Public debate regarding renewable energy generation has mainly focused on two issues: reliability and dispatchability. Reliability is a function of the overall market and the balance between supply and demand, not just the actions of new entrant generators.

Higher levels of wind and solar generation do not threaten reliability, provided investors can respond to market requirements and build sufficient dispatchable generation. This is particularly important when existing generators are retired, causing a sudden drop in available capacity.

One of the advantages of wind technology is its high energy return on the energy invested. Wind technology both on and offshore has a high energy return on energy invested compared to existing conventional energy sources, such as coal, and other renewable technologies. Due to high energy return from wind energy, the requirement to harness the wind more effectively has helped to drive the evolution of wind technology.

3.5.2.3 Life Cycle Assessment

WTGs require energy and materials to be spent during the manufacturing stage of component production (blades, towers, generators, etc) and therefore a certain amount of carbon dioxide equivalents will be produced as a result. In comparison to other forms of energy, such as coal and nuclear, onshore wind farms have relatively low carbon intensities, as seen in Figure 3-11.

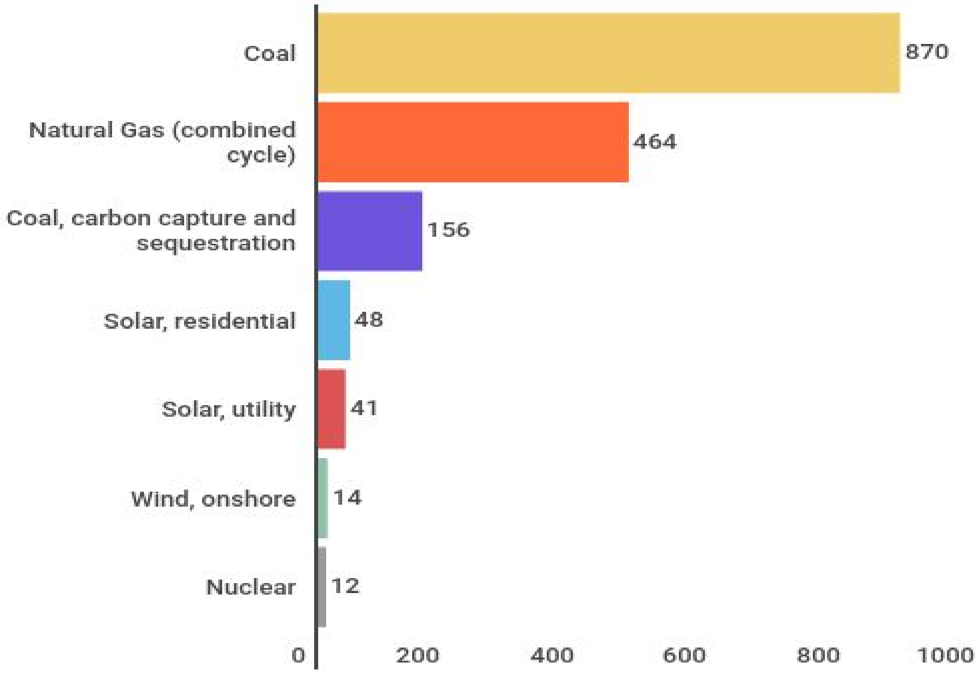


Figure 3-11: Estimated carbon footprints; grams of CO_2 per kilowatt of electricity produced (University of Texas Energy Institute, 2017)

To further analyse the carbon footprint of a WTG Life Cycle Assessment (LCA) can be undertaken which identifies areas in the manufacturing and construction of the WTG where carbon dioxide emissions can be reduced. The main steps of the LCA for a WTG are displayed in Figure 3-12.

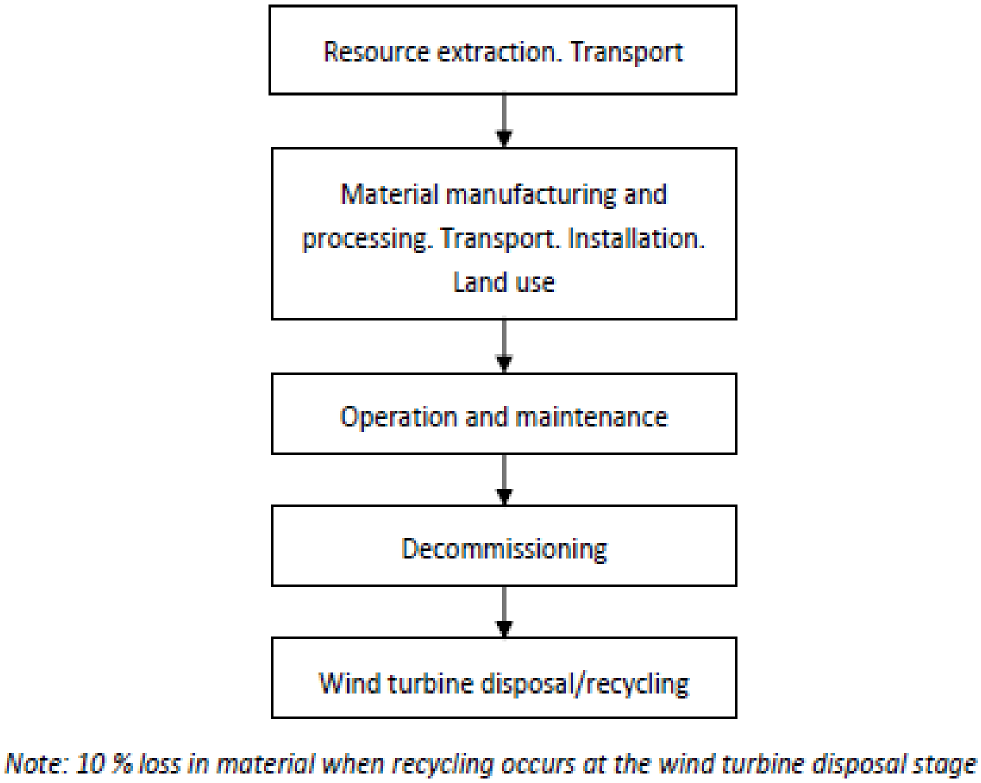


Figure 3-12: Life Cycle Assessment model of a WTG (Adapted from Martinez *et al.* 2009)

In general, the time for a WTG to repay the energy used in construction ranges from five to eight months (Martinez *et al.* 2009; Tremeac & Meunier, 2009; Elsam, 2004; DECCW, 2008). Of the processes involved; manufacturing has the largest impact in producing carbon emissions. However, energy consumed during manufacture is balanced by energy saved by the recycling of components following decommissioning (Martinez *et al.* 2009; Tremeac & Meunier, 2009).

3.5.2.4 Health

The National Health and Medical Research Council (NHMRC) and the Australian Medical Association (AMA) both hold the position that there is no evidence suggesting that wind farms are harmful to human health. Wind farms do not emit any greenhouse gases or harmful air pollutants which can have significant health impacts. Infrasound or low frequency sound generated by wind farms is well below the level that would impact humans.

Following comprehensive assessment of the scientific evidence on wind farms and human health, in 2015 NHMRC released a statement concluding:

> '*there is currently no consistent evidence that wind farms cause adverse health effects in humans.'* (NHMRC, 2015).

The Proponent will continue to stay up to date with the latest scientific research and advice from the National Wind Farm Commissioner and the Independent Scientific Committee regarding the impacts of wind farms on human health.

3.5.3 Community Support

3.5.3.1 Community Attitudes to Renewable Energy in NSW

The NSW Office of Environment and Heritage (OEH) commissioned Newspoll to conduct telephone interviews to study the awareness and attitude of communities to renewable energy, in particular wind and solar farms, across NSW over August and September 2014. A total of 2000 people aged 18 and over were surveyed and the key findings of the survey report include (OEH, 2015):

- Overwhelming support for the use of renewable energy across NSW. Nine out of 10 respondents strongly supported (49%) or supported (43%) electricity generation from renewables.;
- Eighty-three per cent of survey respondents wanted more electricity generated from renewable sources over the next 5 years;
- Most respondents were aware of solar and wind as renewable energy technologies; and
- Most respondents outside of metro areas supported the development of wind (59%) and solar (78%) farms, even close to home.

3.5.3.2 Broad Public Interest in Renewable Energy

As outlined within the Wind Energy Guidelines (DPE, 2016a), both the Proponent and decision-maker are required to consider the public interest, which includes consideration of the objects of the EP&A Act and the principles of ESD. Provided the recommended mitigation measures, as detailed in this EIS, are implemented, environmental impacts associated with the Project are expected to be acceptable.

A Community Survey of Landscape Values was undertaken by Moir Landscape Architecture (2020) to assist in identifying key landscape values. Of the 24 responses, there was general support for renewable energy investment in the region however, 77% of those surveyed believed there would be a negative impact on the character of the local landscape. Although it is acknowledged that visual amenity impacts to some landowners will occur, it is considered that the overall public benefits, such as a sustainable, renewable energy generation source, outweigh any private dis-benefits to the community or specific landowners. This opinion coincides with the final judgement of the Land and

Environment Court hearing of the Taralga Landscape Guardians Inc. v Minister for Planning and RES Southern Cross Pty Ltd in 2007.

3.5.4 Project Substantiation

The Project provides a suite of benefits to the broader community, while facilitating an ordered and systematic move away from traditional and outdated power generation technologies. The design, construction and operation of the Project, including the WTG layout and associated infrastructure is substantiated through its capacity to maximise the utilisation of available wind resources, whilst minimising environmental and social impacts, within economically responsible and sustainable constraints.

The Project has been designed, refined and improved over an extended period of time to maximise positive outcomes while minimising potential negative impacts. In seeking statutory approval, the Project responds to SEARs developed to ensure the maintenance and protection of key environmental issues and adherence to legislative requirements.

3.5.5 Consequence of not proceeding with the Project

Australia has made significant progress towards establishing guidelines and targets that will reduce carbon emissions and promote both renewable energy and energy efficiency. With regards to a prominent target, the NSW Government has stated it will seek to attract a large portion of the investment that will result from the Renewable Energy Target (NSW Trade and Investment 2012). Without this Project, other projects will need to be developed to meet the Large-scale Renewable Energy Target (LRET), and there is potential for the NSW Government to miss out on the significant investment, estimated to be over $30 million, into the Australian economy during over the 30 year life of the wind farm, that the Project is expected to deliver.

Similarly, on an International scale, Australia is currently on track to fulfil its Kyoto Protocol target on emission reductions (DCCEE, 2012c). As electricity demand increases, it will be vital for an increasing proportion of Australia's energy mix to be renewable energy, to remain on track to meet the target. Large scale wind energy production, and importantly this Project, will contribute to ongoing reductions in carbon emissions. Without this Project, and others like it, coal will continue to play a dominant role in meeting energy demand, and Australia's carbon emissions will continue to increase, making it harder to meet the Kyoto Protocol, and other such national and international targets.

Finally, coal mining, and coal fired power generation, is placing increasing pressure on limited natural resources in Australia, including land and water (McAlpine, 2012). For example, coal fired power stations use large volumes of water for cooling purposes during operation. The National Water Commission has identified that power stations often obtain their water at sub-commercial rates, so no economic incentives exist to encourage investment in more efficient technologies (Smart and Aspinall, 2009). Equally, coal mining is generally not able to co-exist with farming activities, and often requires substantial areas of, often agricultural, land (McAlpine, 2012). Wind farms, by contrast, use very little water during operation, and comfortably co-exist with agriculture. Investment in low impact technology such as this Project will alleviate some of the concerning resource impacts associated with conventional energy sources. Without such projects, dwindling natural resources will continue to be depleted at an unsustainable rate.

3.5.6 Interaction with the Electricity Network

Since 2008, the NEM has provided a single marketplace for the wholesale trading of electricity across all Australian states and territories, apart from Western Australia and the Northern Territory. The NEM delivers approximately 80% of Australia's electricity consumption, incorporating around 40,000 km of transmission line and cabling to consumers in Australia's east and south-east coasts. The AEMO is the market and system operator of the NEM and manages the supply and demand of the electricity market by ensuring power generation is available at each instant in time to meet the required consumption.

The dominant supply of energy into the NEM for is generated by coal and gas (85% in 2016/17). A significant number of coal-fired generators in the NEM have either advised that they are closing or will reach the expected end of technical life in the next 20 years. (AEMO ISP, 2018). As these resources retire, AEMO's ISP modelling shows that they can be most economically replaced with a portfolio of utility-scale renewable energy generation including storage.

AEMO have identified several highly valued REZs within the NEM with good connection access to existing transmission infrastructure. The Project is located within REZ N3 (the Central-West REZ) which is identified as an immediate AEMO priority zone.

At the state level, the incumbent government has aligned its Electricity Strategy (Nov 2019) with AEMO's recommendation established the Central-West REZ as the pilot REZ for development, targeting the connection of 3,000 MW of new renewable energy capacity to be connected to the network.

The Project is aiming to contribute upwards of 10 % of this target within the Central-West REZ and provide clean, affordable and dispatchable supply of electricity into the NEM, transitioning Australia's electricity market to renewable energy and storage.

3.5.7 Land Suitability and Potential land use conflicts

Although the proposed development temporarily reduces the available land for agriculture during construction, the long-term use of the land for agricultural purposes will not be compromised during operation of the Project. In addition, the potential diversity of income gained by landowners would assist in ensuring traditional rural communities can remain on the land and continue farming during times of drought or other hardship. In response to the *Draft NSW Planning Guidelines: Wind Farms* (DoPI, 2011), NSW Primary Industries provided a submission regarding the siting of wind farms in regional areas and consultation with the Agriculture NSW Division. In their submission, the department clarifies that the Agriculture NSW Division recognises that wind farms comfortably coexist with agriculture; they therefore do not require consultation for this type of development (DPI, 2012).

The Project Site is located within the Dubbo Regional Council LGA, and as part of the former Wellington Council LGA is in the area covered by the Wellington Local Environmental Plan (LEP) (2012). The LEP is an established framework for development within the LGA. Other than minor disruption during construction, the Project would not significantly affect the strategic land use objectives of agricultural farming. Only a very small percentage (1-2 %) of land would be lost to the Project.

The criteria for ascertaining current dwelling entitlements in the Wellington LEP area (i.e. the former Wellington Council LGA) is multifaceted and not simply determined by lot sizes. Additional entitlement criteria require the consideration of (among other matters) listed 'existing land holdings'; the records of which are not readily publicly available.

Visual and noise impacts were also assessed with respect to lots surrounding the Project where a dwelling entitlement (DE) is held and a dwelling application is known to be actively progressed.

3.5.8 Project Design

A range of factors are considered during the 'site selection' phase, which affects the suitability of an area for a wind farm, and which can potentially constrain development. These include:

- Suitable wind resource;
- Ease of connecting to and capacity of the local electricity transmission network;
- Site access and general ground conditions, including slope and geology;

- Proximity to residential properties and the nature of surrounding land uses;
- Availability of WTG sites based on a range of constraints;
- Presence (or absence) of nationally and locally significant areas with regard to environment, landscape, nature conservation, archaeology and cultural heritage; and
- Interest within the community.

3.5.8.1 Wind Resource

Numerous investigations into the wind resource potential at several locations across NSW have revealed some general principles which can be applied to assess the merit of an individual site's wind resource. Wind speeds are likely to be adequate in areas that are:

- Exposed to open water or large areas of open grassland without intervening obstructions. These areas receive a very smooth airflow with a high-energy content; and
- On significantly elevated locations, surrounded by a smooth and gently rounded landscape, thus promoting wind speed-up. The hills and ranges that make up the Project area offer excellent speed-up due to topographical detail.

The Proponent has been monitoring the wind resource using on-site wind monitoring equipment since 2012. The monitoring data has been modelled with long term BoM data from the local area, shows wind speeds that are high and consistent making this wind farm project viable in the selected location.

3.5.8.2 Land Use

The Project is located in a predominantly agricultural area and there is a very low population density within and around the Project. There are no rural villages within 8 km of the Project Site. The small settlement of Goolma located approximately 13 km north east of the Project is the nearest town and has a population of approximately 100 people. Wellington is approximately 14 km west of the Project and is home to about 4,000 people. The Project Site has been adjusted significantly to avoid impacts to rural sub-developments and lifestyle properties to the east of the Cudgegong River.

The remaining infrastructure has undergone extensive design revisions to ensure impacts to neighbours are minimised. WTGs are placed further from non-associated landowners than associated landowners, and WTG locations have been removed from the Project design in order to minimise impacts, as discussed in Section 2.7, Section 8.2 and Section 8.3.

There is no land registered on the NSW Government's biophysical register of strategic agricultural land (BSAL) within 4 km of the Project Site. The Project Site is not considered highly productive farming country due to the remote and rugged landscape.

3.5.8.3 Electricity Transmission Network

Ease of connection to and capacity within the grid can be difficult to assess, given the commercially confidential nature of certain information concerning the electricity distribution and transmission networks, coupled with the complexity and variety of connection options that may be available. However, on a broad scale, areas remote from high voltage overhead transmission lines or from existing population centres are unlikely to offer many feasible opportunities for grid connection. Together with grid connection factors, actual grid capacity and the ability for the electricity grid to absorb wind generated electricity seem to be the principal limiting factors for wind farm development in NSW.

There are existing transmission lines in close proximity to the Project, and the electrical connection points for the Project are described in Section 4.

The Project included three connection options to be considered during the development phase. The Proponent has committed to a single preferred connection option in the north west of the Project Site.

3.5.8.4 Site Access and Condition

There is good road access to the Project Site as discussed in Section 8.5 – several sealed minor roads and numerous unsealed, graded minor roads intersect the project area. These roads connect to sealed secondary roads, with access to State and Federal Highways.

Within the Project Site the land is very remote and rugged with difficult access for landowners and emergency services. The proposed site roads throughout the Project will be very beneficial for landowner use and emergency services such as firefighters. On-site roads have been designed in close consultation with landowners.

The construction of the Project also has potential benefits in tackling bushfires which occur close to and within the Project area, including improved access from new tracks, on-site access roads, fire breaks and reduced lightning strike to vegetation.

3.5.8.5 Stakeholder consultation

Landowners' interests are very important in determining the location of WTGs, as a wind farm cannot be placed on land where the landowners are resistant to the development. There has been extensive consultation with neighbouring landowners which has helped inform the project design and the placement of WTGs, as discussed in Section 6. 152 WTG locations have been removed to accommodate the varying opinions of WTGs and to reduce the visibility and noise impacts from some neighbouring properties and communities. The proposed location of site roads and cable layout options have been developed in close consultation with involved landowners (see Section 6). It is important to note that the layout is still subject to detailed design following project approval.

The Project design has changed extensively since entering the planning system in 2011. Changes have been made as a response to community feedback, land use changes, visual and noise impact studies, environmental investigations, market dynamics and WTG technological advancements. The design iterations and an explanation of the reasons for mitigation are described in Section 2.7.

It is expected that some further adjustment of the WTG locations will occur in response to stakeholder consultation and during detailed design. Access routes will be designed to achieve practical transport paths that minimise disruption to local traffic and environmental impacts. Initial options are currently being reviewed in preparation for consultation with Councils, landowners and local road users.

3.5.9 Size of Proposed Wind Turbines

WTGs come in various sizes depending on use and location. Figure 3-13 below provides a timeline of the different styles of WTGs from the 1970s to the present. It is important to note that new WTG models are constantly being developed and this chart is only representative of the increasing scale of machines over time.

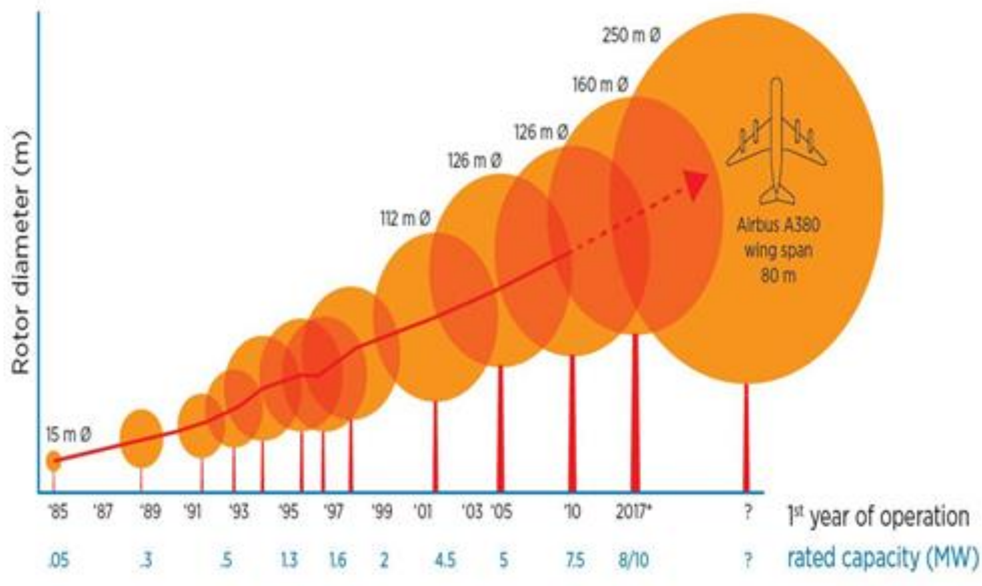


Figure 3-13: Evolution of WTGs (IRENA, 2016)

WTGs technology has changed since the project first entered the planning system. In the 2013 PEA WTGs expected to be suitable for the Project had a generation capacity of approximately 1.5 MW and were up to 192 m in height. A range of WTG sizes are now being considered for the Project based on a review of the market forecast. The dimensions of the WTGs anticipated to be available in Australia in the next few years are currently under review and WTGs between 200 m and 250 m (height from ground to top of blade tip), with generating capacity expected to be upwards of 4MW, are being considered. Larger WTGs enable greater energy generation from a smaller number of machines, lowering the levelized cost of energy.

This EIS includes a thorough analysis of all associated Project impacts, particularly visual amenity and the Proponent has been working closely with neighbours and the community to assess the impacts of the larger WTGs.

3.5.10 Community benefits

The construction, operation and decommissioning of the Proposed Development is evaluated and justified through the consideration of its potential impacts against triple-bottom-line considerations (environment/social/economic) and its potential benefits to the local, regional and NSW community.

The Clean Energy Council's Guide to Benefit Sharing Options for Renewable Energy Projects (2019) provides strategies on different forms of benefit sharing as a means to integrate renewable energy developments into local communities that are beneficial for both the Proponent and local communities. The Proponent has worked closely with the local community in accordance with the Guide to ensure there are mutually agreed opportunities for landowners, neighbours and the wider community to share in the benefits of the development. The Proponent is considering community benefit contributions (discussions ongoing) and community co-investment opportunities (which will be subject to market testing post Development Consent).

Benefits of the proposal have been identified at a global, regional and local scale, including:

- The project has the capacity to supply clean energy to power approximately 170,000 homes and, in the process, to reduce $C0_2$ emissions by 1.1 million tonnes per year;
- Approximately 650 FTE jobs (250 FTE direct and 400 FTE indirect) throughout the construction phase;
- Approximately 47 FTE jobs (12 FTE direct and 35 FTE indirect) throughout the operations phase;
- This level of employment would equate to $10 million in wages (2018 dollars) with a considerable portion to be spent within Dubbo and Wellington;
- An estimated $5.6 million in wages (2018 dollars) would likely be directed to local and regional businesses and service providers during the construction period;
- This level of personal spending would support approximately 28 FTE jobs in the services sector;
- A Community Fund to benefit the local area near the Project;
- Improved security of electricity supply through diversification in the regional generation sources and distribution of wind generators across the state; and
- The project has the capacity to supply sufficient clean energy to power approximately 170,000 homes and, in the process, to reduce $C0_2$ emissions by 1.1 million tonnes per year.

Impacts specific to particular landholders have been mitigated and managed through negotiated voluntary Neighbour Agreements. These agreements and impacts are discussed in Section 5.7.3 and in Section 6.

The Project will play an important role in contributing to both the increasing local and global need for such renewable projects to tackle the issues of global warming and climate change. The electricity generated and dispatched by the Project would result in significant carbon savings due to the electricity displaced from the current NSW generation supply, which is heavily reliant on coal powered generation. Based on current NSW emission figures of 0.87 kg of CO2-equivilent per kWh, up to 1 million tonnes of CO_2 would be displaced by the Project annually.

3.5.10.1 Court Decision Precedent

A recent landmark judgement by the Chief Justice Brian Preston of the NSW Land and Environment Court to refuse the Rocky Hill coal mine, near Gloucester NSW, demonstrates the growing acceptance of the urgent need to reduce greenhouse gas emissions. In his closing remarks, Chief Justice Preston explained the key reasons for refusing the application were the social impacts of the location and the proposal's greenhouse gas emissions contribution to global climate change:

> *"An open-cut coal mine in this part of the Gloucester valley would be in the wrong place at the wrong time … the GHG emissions of the coal mine and its coal product will increase global total concentrations of GHGs at a time when what is now urgently needed, in order to meet generally agreed climate targets, is a rapid and deep decrease in GHG emissions."*

3.5.11 The NSW Wind Farm Greenhouse Gas Savings Tool

As part of the Renewable Energy Precincts initiative the NSW Government has developed the NSW Wind Farm Greenhouse Gas Savings Tool, allowing community and industry to easily calculate the projected greenhouse gas savings from new wind farms in different Renewable Precincts across NSW.

The NSW Wind Farm Greenhouse Gas Savings Tool estimates savings by multiplying the output from a wind farm with the emissions intensity of the electricity supplied in the NEM. The emissions intensity of electricity supplied in the NEM varies according to the location and size of a new wind farm, so site specific emissions intensities must be used for different size developments within each Renewable Precinct. Over time the emission intensity of electricity supplied in the NEM is predicted to reduce with increasing penetration of gas fired plants relative to coal fired plants which have been accounted for in the Greenhouse Gas Savings Tool.

The Project will have an installed capacity of approximately 400 MW, which is dependent on the final WTG model and layout selection, as outlined in Section 4. The NSW Wind Farm Greenhouse Gas Savings Tool (https://www.environment.nsw.gov.au/ggecapp/) (OEH, *no date*) was been used to estimate the greenhouse gas savings at 400 MW using the Central Tablelands Renewable Precinct emission savings.

The estimated annual greenhouse gas savings from an installed capacity of 400 MW is 1,045,800 tonnes of CO2-e. At this capacity, the Project is calculated with this tool to generate 1,245 GWh of electricity annually, enough to power 170,550 homes each year, providing progress towards national and international environmental commitments. The environmental benefits of developing renewable energy sources and transitioning to a low carbon future are manifest, providing potential benefits to the entire community and helping to maintain quality of life.

3.5.12 Further Considerations

Decisions around alternatives will be made during detailed design with a view to minimising environmental and social impacts while maintaining the investment viability, however these will occur at the micro scale rather than macro, site selection, level. The iterative design considerations and alternative WTG layout options have been discussed above and impacts have been analysed throughout this EIS.

Nonetheless, CWPR is developing other renewable projects throughout NSW which may be considered as alternatives to Uungula Wind Farm; though owing to the need for new renewable energy developments it is expected that these will be additive rather than alternative projects.

Post construction, it is proposed that the balance of land would continue to be used for agricultural purposes, resulting in only a minor net change to existing land-use.

4 The Proposal

4.1 Overview

The proposal is to construct, operate, and ultimately decommission and a rehabilitate a commercial-scale wind farm indicatively producing 400 MW of clean energy to power the equivalent of 170,000 average NSW households each year. The inclusion of an ESF will allow for the Project to store and dispatch scheduled and reliable energy to and from the Project or the National Electricity Market (NEM).

The electricity generated and dispatched by the Project would provide significant carbon emission savings relative to the electricity from NSW coal powered generation.

In accordance with long-term strategic plans, the Project is located within the Central West REZ and has been developed through a comprehensive process that incorporates community and stakeholder advice to maximise positive social, economic and environmental outcomes while minimising adverse impacts and unintended consequences.

4.1.1 Project Elements

The Project is generally comprised of WTGs, ESF, Ancillary Infrastructure and Temporary Facilities identified in Table 4-1. Detailed descriptions of each Project element are provided in the following sections and accompanying figures. An outline of the construction and operational phases of the Project are also provided, along with a timeframe detailing the proposed stages of activity.

Table 4-1: Project components and approximate dimensions

Project Components and Infrastructure	Approximate Dimensions[1]	Quantity
	WTGs	
WTG height	Up to 250 m	
Rotor diameter	170 m	97
Uppermost blade tip	250 m	

[1] Area stated is approximate, subject to post-Development Consent, tender, contractor selection, optimisation, detailed design and procurement process.

Project Components and Infrastructure	Approximate Dimensions[1]	Quantity
Lowermost blade tip	40 m – 80 m	
Tower (hub) height	125 m – 166 m	
WTG foundations	27 m diameter	
	ESF	
Compound	150 x 150 m	1
	Ancillary Infrastructure	
Hardstands	50 x 40 m	97
Internal Roads and drainage	9 m x 90 km	N/A
Substations	Up to 220 x 160 m	Up to 3
O&M Compounds	100 x 100 m	2
Overhead transmission lines (high voltage)	12 km external overhead cables (i.e. high voltage transmission lines from the Substation to the grid connection point) with easement width approximately 45-60 m.	N/A
Overhead transmission lines (medium to low voltage)	15 km internal overhead cables (i.e. transmission lines from the WTGs to the Substations) of easement width approximately 30 m.	N/A
Permanent Meteorological Masts (concrete footings for mast and guy wires)	Ten footings of 1 m^2 per mast	6
Underground transmission lines (medium to low voltage)	3 m x 90 km	N/A
Earthworks for Permanent Infrastructure (roads / hardstands) and for temporary facilities[2]	Subject to final design	N/A
	Temporary Facilities	
Concrete (or asphalt) batching plants	50 x 100 m	3
Rock crushing facilities	50 x 100 m	3
Site compound and office	300 x 200 m	2
Stockpiles and materials storage compounds	Subject to construction requirements	

[2] Noting that earthworks, whether for Permanent Infrastructure or Temporary Facilities, will be rehabilitated to stabilize soils however are all included in the Development Footprint (refer to Key Terms table).

Project Components and Infrastructure	Approximate Dimensions[1]	Quantity
Temporary Field Laydown Areas	Subject to construction requirements	N/A
Temporary Meteorological Masts (concrete footing for mast and guy wires)	Ten footings of 1 m^2 per mast	12

4.1.2 Subdivision

4.1.2.1 TransGrid Subdivision(s)

TransGrid requires freehold title to the Substation lot(s) in order to proceed with the construction of the relevant electrical connections and infrastructure. Accordingly, this Development Application seeks consent for the creation of potentially three new lots (with an approximate area of 150 m by 150 m or 220 m by 160 m) by subdivision to enable ownership of the Substations to be transferred to TransGrid. TransGrid will obtain freehold title either through transfer, dedication or acquisition.

Maps identifying the potential TransGrid Subdivision(s) are included as Figure 4-1, Figure 4-2 and Figure 4-3. The potential substations lot and resultant lots are also outlined in Table 4-2. TransGrid has not yet settled on the final preferred connection configuration. Accordingly, this application seeks consent for all of the TransGrid Subdivision options on the basis that any or all Substations will be constructed. Selection of the final connection configuration will be completed as part of the pre-construction final layout plan and prior to the application for the subdivision certificate under Part 6 of the EP&A Act.

No existing dwellings are located on the Substation lots or the residual lots. The size of the final residual lot will depend on the final connection configuration that is chosen i.e. whether one, two or all three of the Substations are progressed. Depending on which of the options are progressed, the residual lot(s) may contain the other Permanent or Temporary Infrastructure.

Table 4-2: Potential substations lot subdivision and resultant lots

Substations Options	Lot	DP	Lot Size (ha)	Substation Lot Size (ha)	Residual Lot Size (ha)
1	2	586633	563	3.52	559.48
2	120	754290	337	2.25	334.75
3	80	750778	16	2.25	13.75

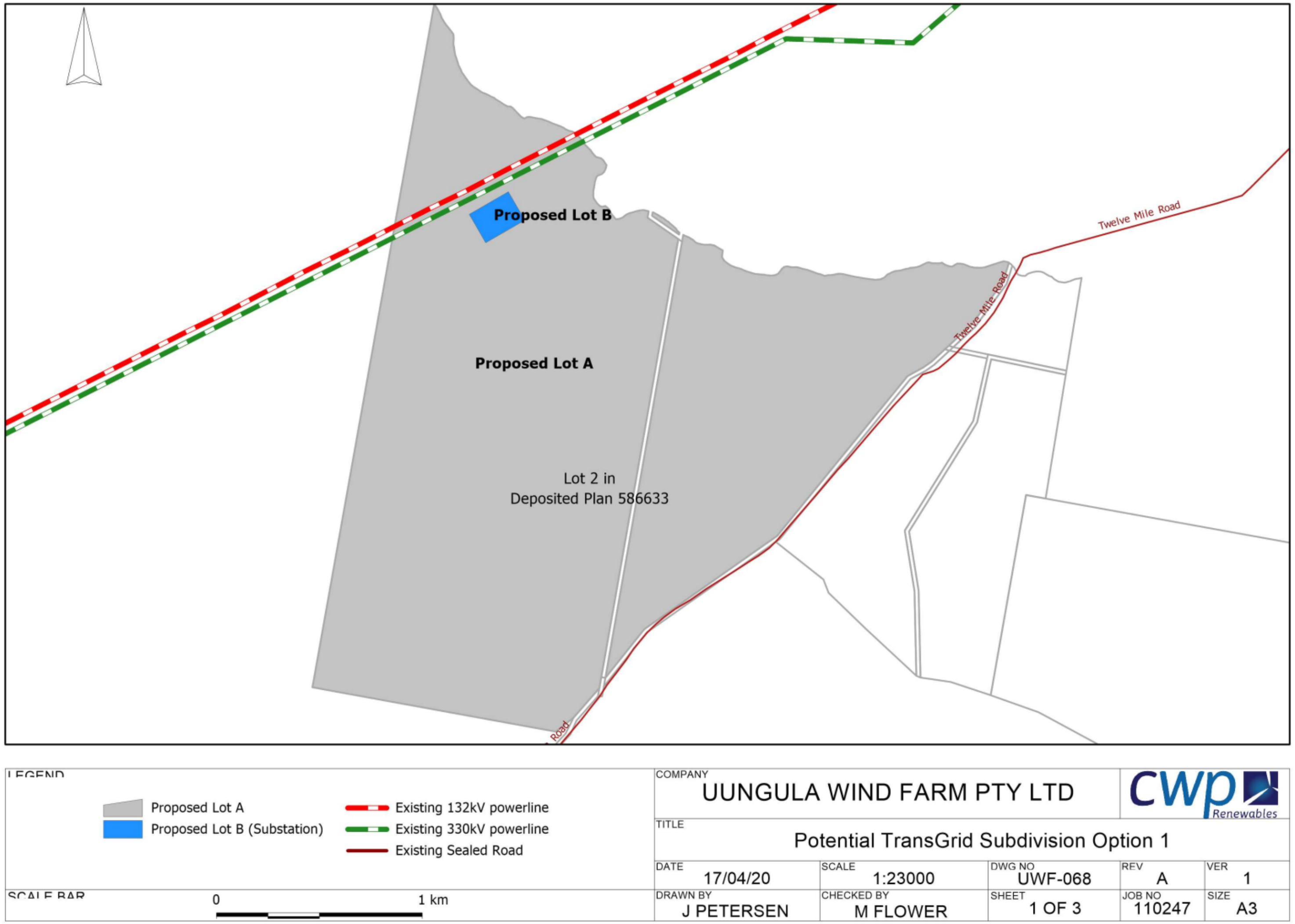


Figure 4-1: Potential TransGrid subdivision option one

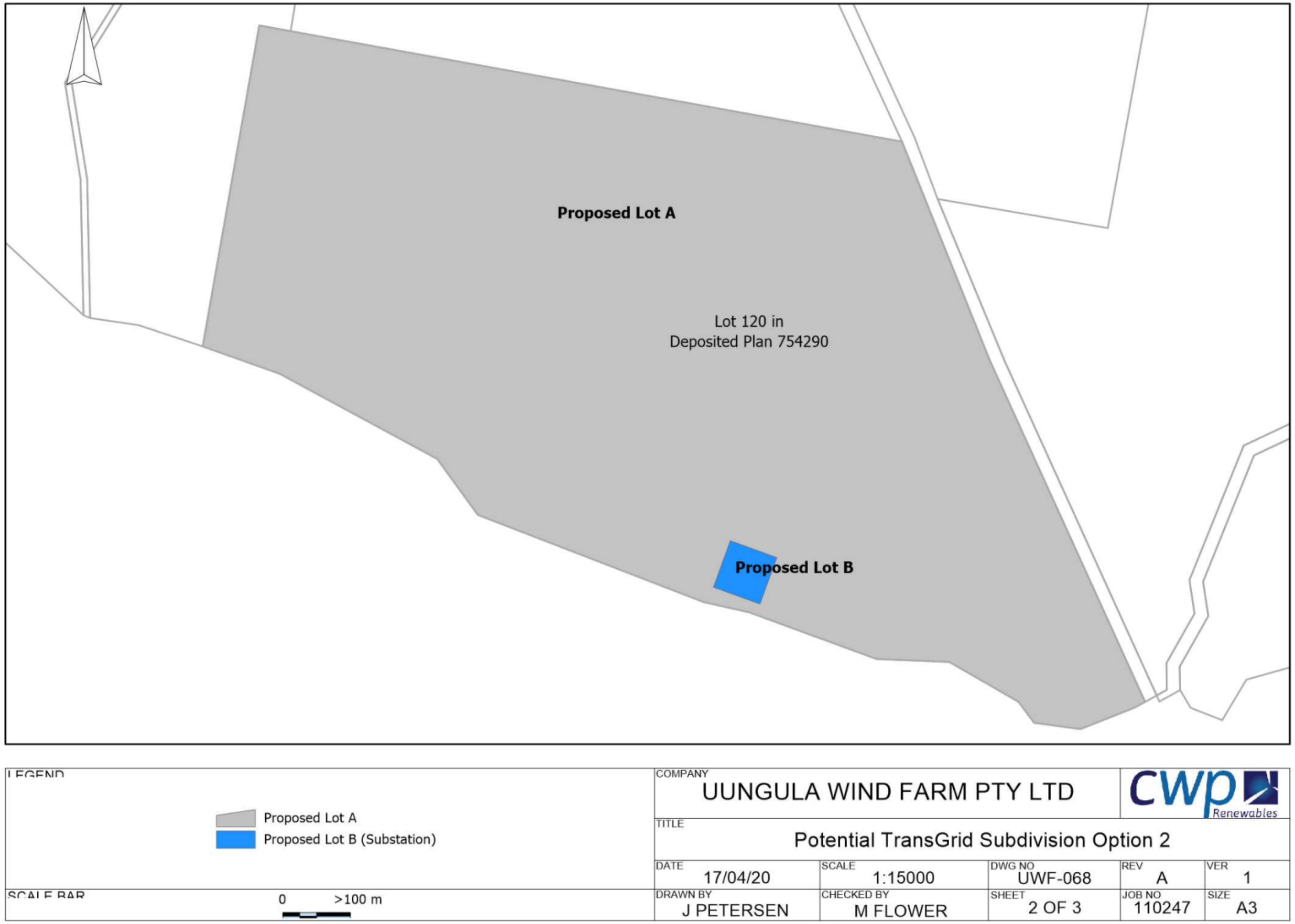


Figure 4-2 Potential TransGrid subdivision option two

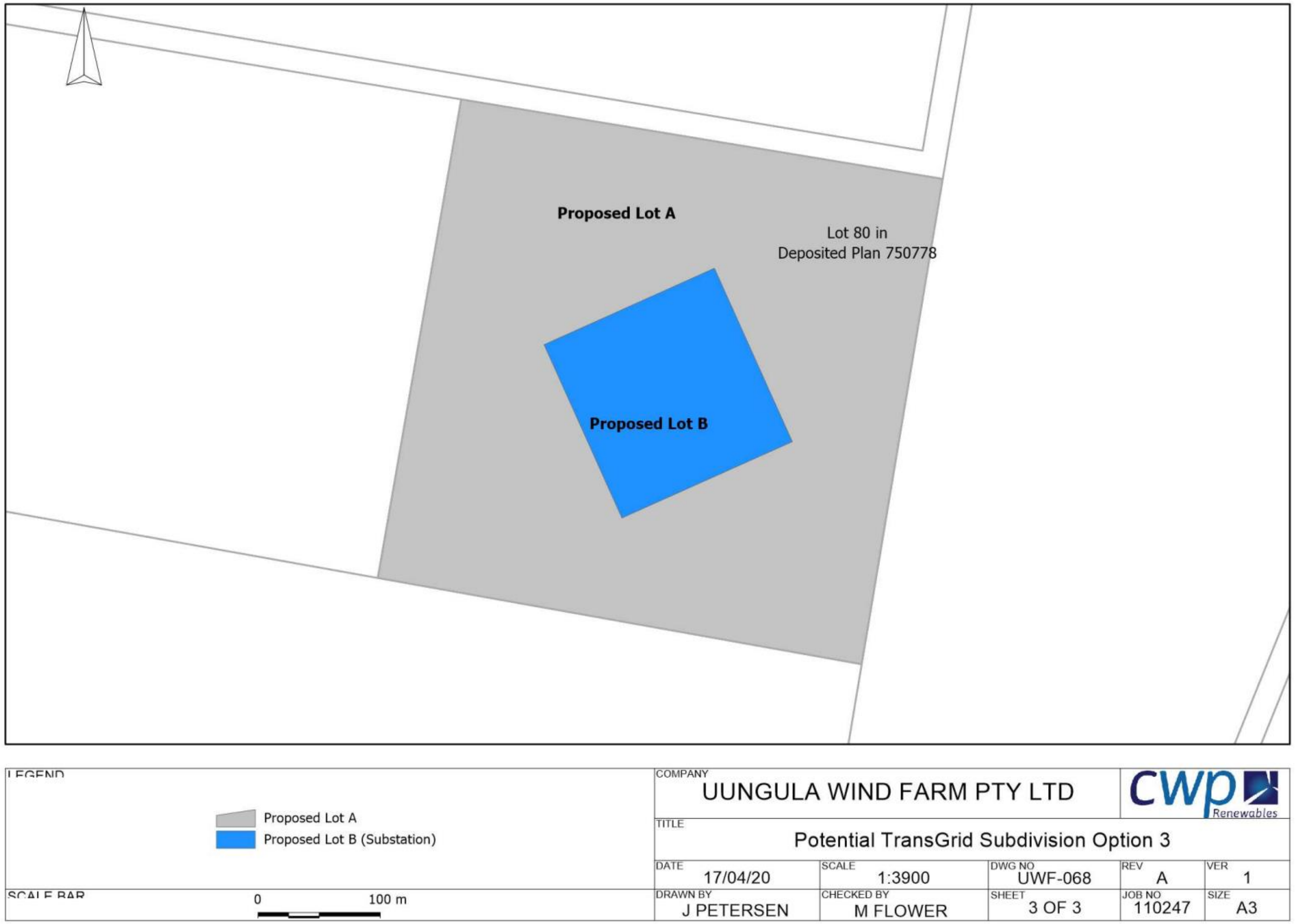


Figure 4-3 Potential TransGrid subdivision option three

4.1.2.2 Lease Subdivision

The Project extends over several adjoining properties. This means that, in order to finance and carry out the Project, the Proponent requires separate long-term leases (with durations in excess of five years) to be granted by each of the registered proprietors over parts of existing lots where the WTGs will be constructed.

In addition to the leases required for the WTGs, a long-term lease is also required for the proposed overhead transmission line (shown in orange on Figure 1-2) to connect the Substations. Figure 4-4 and Figure 4-5 show maps of the indicative lease subdivision across the Project Site.

The intent of a Lease Subdivision is administrative in nature. It is merely the legal mechanism to enable the Project to be carried out. It does not change the nature or scope of the Project. There will be no actual subdivision of the relevant titles to create new freehold lots or which could give rise to any new dwelling entitlements. Therefore, a Lease Subdivision does not result in any fragmentation of agricultural land and/or create potential land use conflicts.

4.1.2.3 Requirement for development consent

Development consent is required for the subdivision of land for lease purposes. “Development” for the purposes of the EP&A Act includes the “subdivision of land” (section 1.5(1)(b) EP&A Act). The definition of “subdivision of land” in Section 6.2 of the EP&A Act means the “division of land into two or more parts that after the division would be obviously adapted for separate occupation, use or disposition”. The division may be affected by any agreement, dealing, plan or instrument rendering different parts of the land available for separate occupation, use or disposition. This includes the grant of a lease of a part of a lot.

The definition of “subdivision of land” also includes the procuring of registration in the office of the Registrar-General of a plan of subdivision within the meaning of section 195 of the *Conveyancing Act 1919* (Conveyancing Act). Section 195 of the Conveyancing Act specifies that “plan of subdivision” includes any plan that shows the division of land.

4.1.2.4 Interaction with the Conveyancing Act

Further, under section 23F(2) of the Conveyancing Act, the Registrar-General may refuse to register a “transaction”, including the lease of part of an existing lot for a period exceeding five years, unless it is shown on a “current plan” and the boundaries of each part into which the land is divided follows the boundaries of an existing lot. The exception to the application of section 23F, in section 23G(e) of the Conveyancing Act for a "transaction" that comprises the lease of a building, will not apply to the location of the WTGs the subject of this application as they will not have been constructed at the time the options to each of the leases are required to be exercised.

As the long-term leases arising as a result of the landowner agreements will be over parts of existing lots and will exceed five years, the Registrar-General will not register the leases unless the relevant lots are deemed to be subdivided so that the leases are for the whole of each 'lot'. That a lease of part of an existing lot of land for greater than five years creates a subdivision under the Conveyancing Act is explained in the Registrar-General's Guidelines for Lease of Land. The proposed subdivision plans are shown in Figure 4-4 and Figure 4-5.

The Proponent has set out below an assessment of permissibility of the Lease Subdivision within the planning framework. The consent authority can take comfort that the Lease Subdivision is permissible and will not create any fragmentation of agricultural land.

4.1.2.5 Registration

Once the leases are granted, they will be registered on title with NSW Land Registry Services (LRS). As the leases will exceed five years, the Registrar-General will not register them unless the relevant lots are deemed to be subdivided so that the leases are for the whole of each 'lot' (Conveyancing Act, section 23F(2)). To satisfy this requirement, deposited plans for lease purposes must be created to show the boundaries of the leased areas.

The leased areas for the WTGs will be circular shaped sites to accommodate dimensions of the WTGs (in particular the extent of the rotor) and centred on the location of each WTG. The deposited plans for lease purposes will also identify easements for access and services connecting to each WTG.

The lease area for the proposed overhead transmission line will be in a standard form as identified in Table 4-2 above and in the location identified in Figure 1-2.

The leases will be registered on the existing titles only and will not subdivide the underlying titles to create new titles. The reason that the long-term leases are not registered over the whole of the existing lots is to allow the current registered proprietors to continue to maintain control over the majority of their land, and use that land, for ongoing agricultural purposes.

Once a lease is registered, the title search will state that a lease over a windmill site, together with an easement of access and services as shown on the deposited plan, has been granted to the Proponent.

Following the expiry or earlier termination of the leases, a landowner may request that LRS remove the lease from their title.

4.1.2.6 Permissibility of subdivision

The Project Site is zoned RU1 Primary Production under the Wellington LEP 2012. Subdivision is permissible with development consent under the LEP (clause 2.6).

Clause 4.1(3) of the LEP requires that any resulting lot be of a specified minimum size shown on the Lot Size Map. The applicable minimum lot sizes under the LEP are 400 ha and 2,000 ha. The Proponent has undertaken an analysis below of the TransGrid Subdivision and Lease Subdivision against the objectives of cl 4.1 of the LEP.

The Proponent notes, however, that section 4.38(3) of the EP&A Act allows development consent to be granted to the Project despite the development being partly prohibited by an environmental planning instrument (which includes an LEP). Accordingly, under the applicable statutory framework, regardless of the controls set out in the LEP, consent for subdivision can be granted.

Table 4-3: LEP Provisions and subdivision

LEP Provision	Lease Subdivision Analysis	TransGrid (Substation) Subdivisions(s)
Clause 4.1 (Minimum subdivision lot size) (1) The objectives of this clause are as follows:		
(a) minimise the cost to the community of— (i) fragmented and isolated development of rural land, and (ii) providing, extending and maintaining public amenities, infrastructure and services,	(a) This objective is not relevant as the Lease Subdivision: (i) will not result in the fragmented and isolated development of rural land; and (ii) will not impose any cost to the community for the provision, extension or maintenance of public amenities, infrastructure and services.	(a) There is no expected cost to the community from the TransGrid Subdivision(s): (i) the TransGrid Subdivision(s) will result in minimal, if any, additional fragmentation and isolated development of rural land to the impacts of the Project as a whole. (ii) the TransGrid Subdivision(s) alone will not require the provision, extension or maintenance of public amenities, infrastructure and services.
(b) to ensure that the character and landscape setting of an area is protected and enhanced by any development	(b) This consideration is not relevant because the Lease Subdivision will not affect the character and landscape setting of the area.	(b) The TransGrid Subdivision(s) will have minimal, if any, additional effect on the character and landscape setting of the area to the impacts of the Project as a whole.
(c) to ensure development is undertaken on appropriately sized parcels of land commensurate with available services (including any associated sewerage management systems) and responds to any topographic, physical or environmental constraints,	(c) This consideration is not relevant as the Lease Subdivision will not result in any actual subdivision of the relevant titles. The subdivision of land would create leasehold lots of appropriate size to meet the needs of the Project.	(c) TransGrid will be the registered proprietor of the new lot(s) and there is no intention for any future development to be carried out on that lot. Access to the existing transmission line is one of the key considerations in identifying the options for the Substation(s). The topographic, physical and environmental constraints of the location options have also been considered.

LEP Provision	Lease Subdivision Analysis	TransGrid (Substation) Subdivisions(s)
(d) to ensure sufficient land area to promote high levels of residential amenity	(d) This consideration is not relevant as the Lease Subdivision will not result in any actual subdivision of the relevant titles.	(d) The TransGrid Subdivision(s) only involves a small parcel(s) of land and therefore is not expected to affect the amount of land area available for residential amenity.
(e) to ensure that subdivision and lot sizes result in a practical and efficient layout to meet the intended use and provide ease of access and connectivity.	(e) This consideration is not relevant as the Lease Subdivision will not result in any actual subdivision of the relevant titles.	(e) The TransGrid Subdivision(s) and lot size will meet the intended use of the land as a Substation(s). Ease of access has been considered in identifying the location options, and it will be one of the key considerations in choosing the final location of the proposed substation. As TransGrid will be the registered proprietor of the new lot there is no intention for any future development to be carried out on that lot.

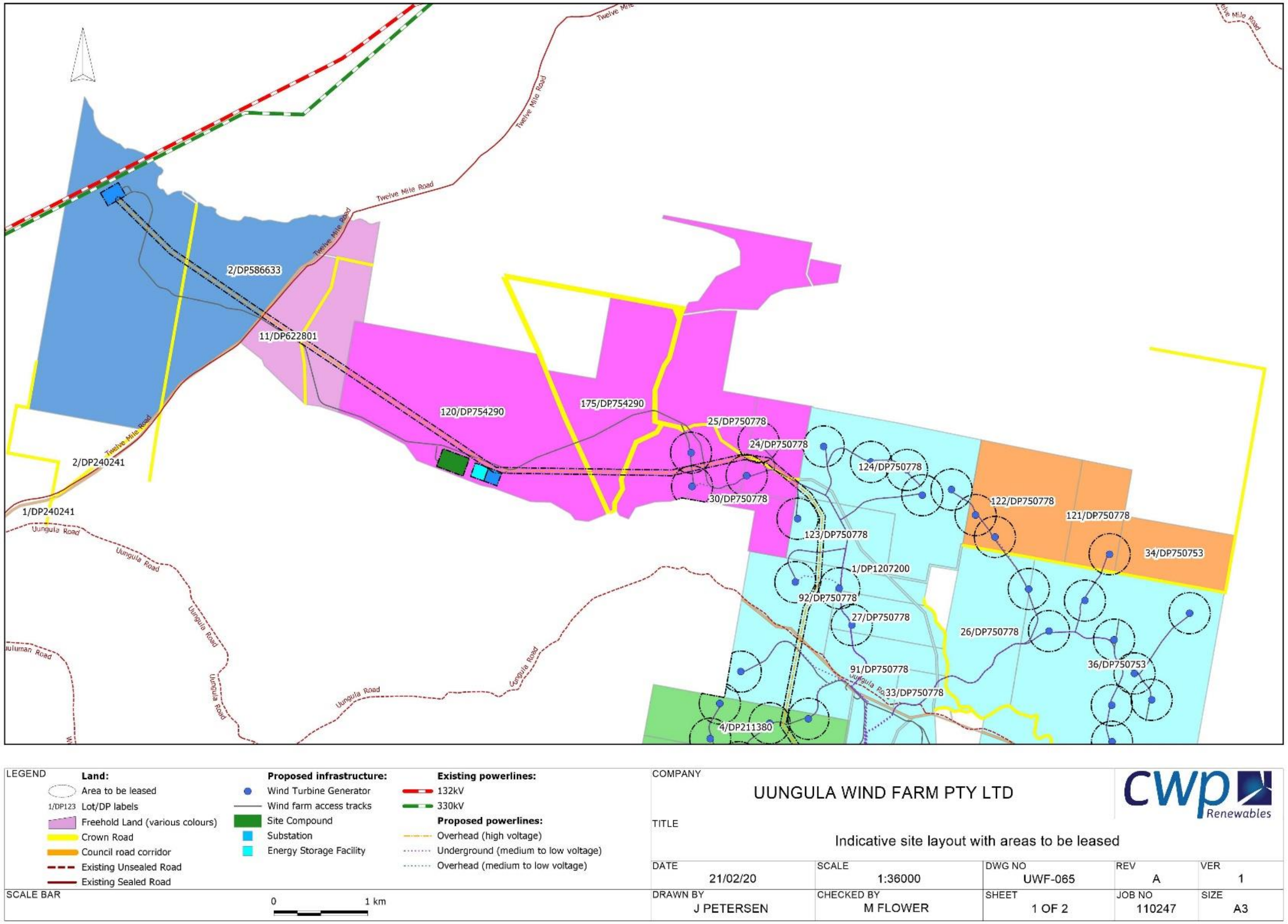


Figure 4-4: Indicative lease subdivision map (part one)

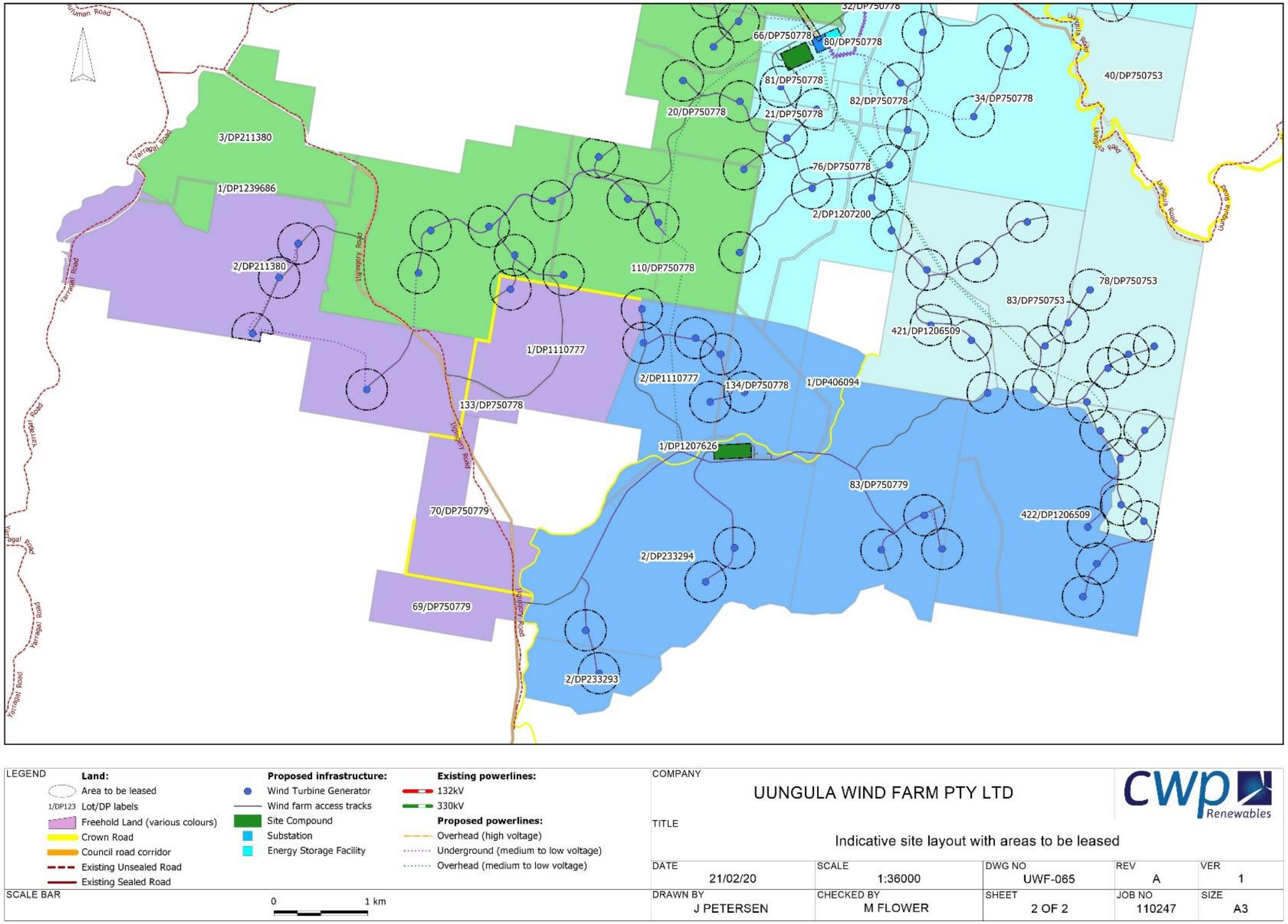


Figure 4-5: Indicative lease subdivision map (part two)

4.1.3 Site Access

The Project Site will be accessed from the public road network at the following locations during construction and operation:

1. Primary Project Site entry off Twelve Mile Road, approximately 17 km east of Wellington (by road). This will be the sole access point for Oversize and/or Overmass (OSOM) vehicles and the main access point for Heavy and Light Vehicles; and
2. Secondary intersections and cross-over locations along Uungula and Ilgingery Roads. These secondary access points will facilitate the routes of Internal Roads throughout the Project Site required for construction and operational vehicles.

4.1.3.1 Site access Limitations and Exceptions

To limit impacts to road users and the surrounding community, it is proposed that:

1. The primary Project Site entry will only be accessed from a westerly direction (from Goolma road along Twelve Mile Road), except to allow local service and/or resource suppliers located east of the primary Project Site entry along Twelve Mile Road the opportunity to participate in the Project. Therefore, an exception is sought to not prohibit Heavy and Light Vehicles to use Twelve Mile Road east of the primary Project Site entry should service and/or resource suppliers be identified;
2. A short section of Ilgingery Road will be used during construction and operational activities for OSOM, Heavy and Light Vehicles, which for the absence of doubt, will gain access via the primary Project Site entry and Internal Roads, to access a small number of WTGs at the western edge of the layout.
3. The sections of Uungula, Wuuluman and Ilgingery Roads linking the Project back to Twelve Mile Road will not be used by the Project during the post-Development Consent, construction or operational periods for any vehicles, except to:
    a. undertake Pre-construction Minor Works;
    b. construct intersection upgrades on Uungula Road and Ilgingery Road;
    c. undertake dust suppression;
    d. utilise the secondary intersections and cross overs identified above to facilitate construction and operational vehicles; and
    e. procure resources from licensed operators which are located along these roads.

Project Site access points would be gated and secured, and appropriate warning signs erected. Access routes and points for Project transport have been discussed and assessed in the relevant impact assessment sections (Biodiversity (Section 8.4); Traffic and Transport (Section 8.5); and Heritage (Section 8.7)).

4.1.3.2 OSOM Vehicle Transport Route from Port of Entry

As the nearest seaport to the Project Site is the Port of Newcastle, it is the most likely port of entry for shipped Project components, so assessment was undertaken of the vehicle transport from that port. However, the port of entry will not be known until post-Development Consent tender, contractor selection, optimisation, detailed design and procurement process is complete, and as such an alternative port may need to be used. OSOM vehicle transport to the Project Site from the Port of Newcastle has been assessed in a route study contained in Section 8.5. It is notable that although future commercial procurement decisions will largely determine the most suitable port of entry, other ports of entry can be used which would then link with the studied route. The route from the Port of Newcastle for OSOM vehicle transport would be via:

- Industrial Drive;
- Pacific Highway;
- John Renshaw Drive;
- Hunter Expressway;
- New England Highway;
- Golden Highway (a detour around the Denman Bridge from the corner of Golden Highway and Denman Road via Bengalla and Wybong Roads may be required for any vehicles exceeding 5.6 m in height although at this stage no vehicles are proposed exceeding this height);
- Saxa Road (formerly Cobbora Road);
- Mitchell Highway;
- Goolma Road; and
- Twelve Mile Road

Due to various road network and land use constraints, the preferred road transport route for OSOM on approach to the Project Site is via Dunedoo on the Golden Highway then left turn south onto Saxa Road, left turn south east onto Mitchell Highway, left turn north onto Goolma Road, right turn onto Twelve Mile Road to the primary Project Site entry.

Further, a WTG blade transport modelling exercise has been undertaken along Twelve Mile Road to analyse how an OSOM vehicle carrying a blade suited to the Project parameters may negotiate the current road geometry. This allows an analysis of the areas where the road pavement may require extension to allow the wheel-to-ground contact for a vehicle to turn a corner and where the vegetation adjacent the road will require either pruning or clearing to allow the passage of the blade which oversails outside the line of wheel-to-ground contact.

This area of wheel-to-ground contact and blade oversail plus an additional area of 5 m outside of that on both sides has been considered as the area of impact forming part of the External Road Upgrades required on Twelve Mile Road for the Project. The final road design, and extent of pruning and clearing for the External Road Upgrades, is subject to the post-Development Consent process which includes tender, contractor selection, optimisation, detailed design and procurement process undertaken where applicable in consultation with the Dubbo Regional Council and Transport for NSW. It is intended that the final road design for the External Road Upgrades will remain within the impacts assessed in this EIS. The impacts associated with this are analysed in the relevant sections of the EIS (Biodiversity (Section 8.4); Traffic and Transport (Section 8.5); and Heritage (Section 8.7)).

The inclusion of an additional 5 m area beyond the modelled wheel-to-ground contact and blade oversail extent considered as a worst-case scenario considering that along straight stretches of road there will be minimal need to undertake earthworks on the pavement edges or clear the vegetation adjacent the road within that additional area on both sides of the OSOM vehicle.

4.1.3.3 Vehicle Routes, Upgrades and Timing

OSOM, Heavy and Light Vehicle routes will be further defined during the post-Development Consent period in the preparation of the Traffic Management Plan (TMP) and in consultation with Transport for NSW and Dubbo Regional Council. Design, consultation and timing regarding road upgrades are outlined in Table 4-4.

Table 4-4: Road and intersection upgrades required

Road / Intersection	Upgrade	Timing	Consultation
Twelve Mile Road	External Road Upgrades	During Pre-construction Minor Works and prior to commencement of construction	Dubbo Regional Council
Primary Project Site entry	Construct intersection in accordance with the Austroads Guide to Road Design as	During Pre-construction Minor Works and prior to commencement of construction	Dubbo Regional Council

	amended by the supplements adopted by Transport for NSW		
Secondary Project Site entries	Construct intersection in accordance with the Austroads Guide to Road Design as amended by the supplements adopted by Transport for NSW	During Pre-construction Minor Works and prior to commencement of construction	Dubbo Regional Council
OSOM vehicle transport route from port of entry to the Project Site	External Road Upgrades	Prior to OSOM vehicle transport	Transport for NSW and relevant Council

Further details relating to safe access considerations and potential road infrastructure upgrades to be considered are discussed in Section 8.5 (Traffic and Transport).

4.1.4 Resource Requirements

Resource requirements are typical of any new development site, including the provision of cement, aggregate, sand, asphalt, water and road base material. Cement for foundations will be sourced by the civil construction company selected to construct the Project by the Proponent. This may be sourced locally or from alternative suppliers. Aggregate and sand will be sourced locally and as close to the Project Site where it is practicable to do so, including recycling material excavated from foundations and earthworks where possible. If it is decided to pursue the establishment of a local quarry, then this will be separately assessed and approved under the relevant planning instrument. Both aggregate and sand will be required to prepare the high strength concrete to pour WTG foundations. Aggregate will be required to dress the WTG sites and provide a low resistivity apron around the ESF and Substations.

Water requirements will be met in accordance with the provisions of the *Water Management Act 2000* (WM Act) by sourcing water from within the locality where practicable and from a licensed supplier. If it is not practicable to source water locally, then it will be brought to the Project Site by licensed external water suppliers under contract to the Project. It is estimated that in the order of 15.0 mega litres (ML) of water would be required to produce the quantity of concrete required for gravity foundations, which can be considered the maximum amount of water required for use in concrete batching.

In addition, it is estimated that a further 80 ML of water would be required for road construction and dust suppression activities during construction. This estimated volume would service all new and upgraded on-site internal road construction and dust suppression activities, including those associated with the unsealed public roads. The water volumes provided above are reasonable with regard to the types of activities proposed, however they are estimates and not limits. Prevailing weather conditions during the period of construction, temperature in particular, will affect the volume of water required.

Road base material will be required for construction of Internal Roads to WTG sites, the ESF and the Substations. Part of the road base requirement may be sourced from material extracted from WTG foundations and any cut and fill from road construction, with the remainder sourced on-site (subject to separate assessment and approvals being obtained) or imported to the Project Site. Where additional material is required, material will be sourced from a suitably approved quarry. Topsoil cleared during the construction phase will be used for rehabilitation, and rock excavated from WTG foundation preparations will be used for road base, back fill for foundations and / or erosion control purposes as far as practicable.

Any waste, such as packaging associated with component deliveries, will be classified in accordance with the Environment Protection Authority's (EPA) *Waste Classification Guidelines* and disposed of appropriately in accordance with procedures which will be contained in an Environmental Management Strategy (EMS).

Procurement of resources required for the Project will be determined during the post-Development Consent tender, contractor selection, optimisation, detailed design and procurement processes and the construction period. These resources may be sourced from locations local to the Project and may require the use of public roads not described in Section4.1.3. Although the source of resources for construction is a commercial procurement decision which will occur post-Development Consent. The routes used to move the resources through the surrounding towns and road network will be along the major road network and standard heavy vehicle road network, or alternatively along routes permitted by the resource supplier's permitting and approvals process. Therefore, flexibility is required in the Development Consent to preserve the opportunity to source locally any of the above resources and to provide the ability to further define road routes for Heavy and Light Vehicles. This will be addressed in the Project TMP.

4.1.5 Project Design Variations

The Project described in this EIS is indicative only and subject to a detailed design process. The indicative layout has been prepared based on the best knowledge available at the time, by applying the avoidance hierarchy approach.

Although 97 WTGs are proposed, commercial considerations and technological advancements may require fewer than 97 WTGs to be constructed and operated, at the discretion of the Proponent. All 97 WTG locations have been included in this EIS in order to assess worst-case impacts and to allow the flexibility to determine the optimal project layout within the limits of the Development Consent, generally in accordance with this EIS, post-Development Consent.

Since the Project was announced, it has been through multiple design iterations as a result of the environmental assessments undertaken for the Project. The resulting design of the Project in this EIS is a product of the Proponent's commitment to avoid environmental impacts and mitigate any remaining impacts to the maximum extent possible. This EIS has considered the worst-case impacts for the resultant Project elements to ensure that the Project can be constructed, operated, maintained and decommissioned within the limits of a typical wind farm Development Consent, and generally in accordance with this EIS.

If Development Consent is granted, preferred suppliers will be selected following a tender and contractor selection process. Each piece of equipment is uniquely different and can include bespoke specifications such as transport vehicle turning radii, access and exit gradients and crane requirements. The final design will only be known following selection of Project components and the completion of the detailed design by the construction contractor post-Development Consent. The ability to micro-site the WTGs, the ESF, Ancillary Infrastructure and Temporary Facilities post-Development Consent is required to enable optimisation of the Project and minimisation of impacts.

Optionality is also provided for in the location of compounds and electrical design (as shown in Figure 1-2) because the selection of the locations of compounds is subject to the post-Development Consent tender, contractor selection, optimisation, detailed design and procurement process. This EIS and Development Application is made on the basis of each of those areas shown can be interchangeable with others should the optimisation process direct that a piece of infrastructure would be more efficiently interchanged with another. All areas have therefore been considered in the Development Footprint and subjected to the impact assessment process.

The locations of some Project elements are not known at this stage and will be subject to the detailed design and construction phase programming. These are described in the relevant section and include (but are not limited to) the Meteorological Masts (both Temporary and Permanent and including the location of their power supply cables) and the Temporary Field Laydown Areas. Those will be located within the Project Site with impact avoidance and minimisation guiding their placement.

4.1.5.1 Micro-siting Criteria

WTGs, ESF, Ancillary Infrastructure and Temporary Facilities will be micro-sited post-Development Consent during the optimisation, detailed design and construction phase programming. Final micro-siting may not occur until during the construction period, immediately prior to the activity or construction of that Project element. Any micro-siting will be undertaken to meet the following criteria:

- On-ground impacts are to remain within the Development Corridor shown in Figure 1-2 (excluding Meteorological Masts and Temporary Field Laydown Areas which may be outside the Development Corridor but will remain within the Project Site);
- No WTG is moved more than 100 m from the relevant Geographical Positioning System (GPS) coordinates shown in Appendix D; and
- The micro-sited location of the WTG, ESF, Ancillary Infrastructure or Temporary Facilities would not result in any non-compliance with the Development Consent once granted.

4.1.6 Project Timeline

It is anticipated that works will commence within one to five years of Development Consent being granted. The timing of construction will principally be driven by additional permits and authorisations, post-Development Consent tender, contractor selection, optimisation, detailed design and procurement processes and a final investment decision. Staging of the Project is also a consideration as discussed below. An indicative Project timeline is presented in Table 4-5 below.

Table 4-5: Anticipated project timeline

Phase	Approximate Duration
Construction	24-30 months
Operation	30 years
Maintenance	Annual and ongoing
Repowering or Decommissioning	At completion of Project life

4.1.7 Staging

It is intended that the Project may be constructed, operated, re-powered and/or decommissioned in stages of various sizes or permutations within the parameters of the Development Consent. Staging would be determined post-Development Consent tender, contractor selection, optimisation, detailed design and procurement processes.

4.1.8 Community Engagement

Prior to the commencement of construction activities, a program of community awareness initiatives will be implemented. Information will be disseminated to the local community through the Community Consultative Committee (CCC), the Project website, local newspapers and direct mail to advise the community of the nature of pending construction activities, their timing and potential impacts. Contact details will be provided for individuals to gain further information or, if desired, to express concerns or complaints.

Updates on the progress of construction works and relevant impacts will be provided during the construction period. The CCC will be available to guide and inform the Proponent on matters of interest to the community and will provide an additional forum for communication between stakeholders. Ongoing consultation activities following lodgement of this EIS are described in Section 6.

4.1.9 Environmental Management

Prior to the commencement of construction, the Proponent will prepare an EMS to the satisfaction of the Secretary of the Department of Planning, Industry and Environment (DPIE) for the Project. The construction contractor will prepare an Environmental Management Plan (EMP) that will outline environmental management measures and procedures to be implemented during construction. This will include plans to address:

- Water quality;
- Air quality;
- Heritage;
- Biodiversity;
- Noise and vibration;
- Environmental incident response and notification;
- Traffic;
- Waste;
- Contamination (including unexpected finds);
- Storage of chemicals, oils and fuels;
- High risk activities; and
- Training and induction.

Prior to the commencement of commissioning of any WTG, the Proponent will prepare a Bird and Bat Adaptive Management Plan (BBAMP) to the satisfaction of the Secretary.

Within two years after construction commencement the Proponent will retire the required biodiversity offset credits in consultation with the relevant NSW or Commonwealth Government agencies and according to the requirements of the relevant legislation.

Further information on these management plans (and requirements) is provided in the sections below.

4.1.9.1 Environmental Management Strategy

The EMS will:

- provide the strategic framework for environmental management of the development;
- identify the statutory approvals that apply to the development;
- describe the role, responsibility, authority and accountability of all key personnel involved in the environmental management of the development; and
- describe the procedures that would be implemented to inform the community, handle, manage and respond to complaints and address emergencies.

The Proponent will implement the approved EMS during construction and operation of the Project.

4.1.9.2 Biodiversity Management Plan

The BMP will be prepared in consultation with the Biodiversity Conservation Division (BCD) within DPIE and will include a description of the measures that would be implemented for:

- minimising the amount of native vegetation clearing;
- minimising the loss of key fauna habitat and impacts on fauna on-site;
- rehabilitating and revegetating temporary disturbance areas;
- controlling weeds and feral pests; and
- a detailed program to monitor and report on the effectiveness of these measures.

The Proponent will implement the approved BMP during construction and operational phases of the Project.

4.1.9.3 Cultural Heritage Management Plan

Prior to the commencement of construction, the Proponent will prepare a Cultural Heritage Management Plan (CHMP) to the satisfaction of the Secretary. This plan will:

- be prepared by a suitably qualified and experienced person whose appointment has been endorsed by the Secretary;
- be prepared in consultation with the BCD within DPIE and Aboriginal stakeholders;
- include a description of the measures that would be implemented for:
    - protecting relevant Aboriginal heritage items identified in the Heritage Assessment and any items located outside the Project disturbance area;
    - minimising and managing the impacts of the development on relevant heritage items identified in the Heritage Assessment;
    - a contingency plan and reporting procedure if:
        - Aboriginal heritage items outside the approved disturbance area are damaged;
        - previously unidentified Aboriginal heritage items are found; or
        - Aboriginal skeletal material is discovered;
    - ensuring workers on-site receive suitable heritage inductions prior to carrying out any development on-site, and that records are kept of these inductions;
    - ongoing consultation with Aboriginal stakeholders during the implementation of the plan; and
- a program to monitor and report on the effectiveness of these measures and any heritage impacts of the project.

The Proponent will implement the approved CHMP during construction and operational phases of the Project.

4.1.9.4 Traffic Management Plan

Prior to the commencement of construction, the Proponent will prepare a TMP for the Project in consultation with Transport for NSW and Dubbo Regional Council, and to the satisfaction of the Secretary. This plan will:

- detail the measures that would be implemented to:
    - minimise traffic safety impacts of the development and disruptions to local road users during the construction and decommissioning of the development, including:
    - consideration of potential interaction with other State Significant Development in the local area in consultation with the applicant(s) of that(those) project(s);
    - temporary traffic controls, including detours and signage;
    - notifying the local community about Project-related traffic impacts;
    - minimising potential conflict between Project-related traffic and:

    - rail services;
    - stock movements;
    - school buses, in consultation with local schools;

  - implement measures to minimise development-related traffic on the public road network outside of standard construction hours;
  - implement measures to minimise dirt tracked onto the sealed public road network from Project-related traffic;
  - ensuring loaded vehicles entering or leaving the Project Site have their loads covered or contained;
  - providing sufficient parking on-site for all Project-related traffic;
  - responding to any emergency repair requirements or maintenance during construction and/or decommissioning;
  - a traffic management system for managing over dimensional vehicles; and
  - comply with the traffic conditions in the Development Consent;

- a driver's code of conduct that addresses:
  - travelling speeds;
  - fatigue management;
  - procedures to ensure that drivers to and from the Project Site adhere to the designated OSOM and Heavy Vehicle routes;
  - procedures to ensure that drivers to and from the Project Site implement safe driving practices; and
  - include a detailed program to monitor and report on the effectiveness of these measures and the code of conduct.

4.1.9.5 Bird and Bat Adaptive Management Plan

Prior to the commissioning of any WTGs, the Proponent will prepare a BBAMP for the Project in consultation with the BCD within DPIE, and to the satisfaction of the Secretary. This plan will include:

- a detailed description of the measures that would be implemented on-site for minimising bird and bat strike during operation of the development;
- trigger levels for further investigation of the potential impacts of the project on particular bird or bat species or populations;
- an adaptive management program that would be implemented if the development is having an adverse impact on a particular threatened or 'at risk' bird and/or bat species or populations;

- a detailed program to monitor and report on:
    - the effectiveness of these measures;
    - any bird and bat strikes on-site; and
- provisions for a copy of all raw data collected as part of the monitoring program to be submitted to the BCD within DPIE and the Secretary.

4.1.9.6 Biodiversity Offsets

This EIS contains a conservative calculation of the biodiversity offset credits required to address the impacts associated with the Development Footprint. Noting that the Project is subject to micro-siting, detailed design, and potentially staging, the biodiversity offset credits are provided as indicative only, and are not presented as a proposed credit requirement.

As outlined in this EIS, the proposed Biodiversity Offsets Strategy (BOS) for the Project is to acquire and retire all ecosystem and species credits. The EIS outlines the Project's approach to achieve the required biodiversity offsets using the calculated biodiversity offsets according to the relevant legislation. The biodiversity offset credit liability will be recalculated using the BioBanking Credit Calculator for Major Projects (BBCC) during the period post-Development Consent based on the impacts of the final Development Footprint, once the detailed design is available. It is noted that if no FBA credits are available as matching credits in the market, credits calculated by the BBCC following assessment under the FBA will require determination of reasonable equivalent credits as determined by the current Biodiversity Offset Scheme under the *Biodiversity Conservation Act 2016* (BC Act), determined by the Biodiversity Assessment Method (BAM).

CWPR is considering the proposed BOS for the Project and the final BOS to be delivered for the Project will include one of the following offsetting options under the FBA:

- Securing land (land-based offset)
    - Preliminary BOS assessment identifies some suitable offset lands and their potential biodiversity credit yield using available vegetation and habitat mapping and condition assumptions. Further investigation is required to refine and validate vegetation mapping to determine the offset potential for proposed offset lands to be chosen, however, the presence and area (ha) of equivalent vegetation communities indicates that land-based offsets will provide a viable mechanism to secure and retire the required biodiversity offset credits.

- The final offset strategy, including the mechanism to provide for the long-term security of the offset area will be discussed and agreed upon between DPIE and CWPR.
- Once a suitable offset has been identified the following will be provided to DPIE:
  - Description of the proposed offset property
  - The mechanism proposed to secure the offset for biodiversity outcomes
  - Ecosystem credit summary
  - Species credits
  - Management actions to improve biodiversity values.

- Securing required credits through the open credit market, and/or
- Payments to the Biodiversity Conservation Fund (established under the BC Act). One of the key functions of the NSW Biodiversity Conservation Trust (BCT) is to secure land-based offsets on behalf of developers who pay into the Biodiversity Conservation Fund (BCT, 2018). Through this process the BCT is able to combine offset obligations and funds to establish strategic, larger and more viable offset sites in NSW (NSW Government, 2018).

4.2 Wind Turbine Generators

The global WTG market continues to develop rapidly with a trend towards larger, higher capacity factor WTGs, enabling a lower levelised cost of energy. Market trends and forecasts from WTG manufacturers indicate that WTGs entering the Australian market in 2021 will rise to up to 240-250 m from the ground to upper blade tip. The Project is therefore designed to accommodate a contemporary WTG of up to 250 m in height varying in generation capacity. By way of example, the Vestas V126 3.6 MW machine as installed at CWPRs Sapphire Wind Farm near Inverell, NSW was the largest WTG in Australia in 2016 standing at a tip height of 200 m and is expected to be superseded by larger models by 2021.

The WTGs will be three-bladed, semi-variable speed, pitch-regulated machines with the rotor and nacelle mounted on a tower with an internal ladder or lift. The WTGs would be installed at final locations to be confirmed within a 100 m micro-siting buffer of the proposed locations identified in Appendix D.

The EIS assumes a rotor of 170 m diameter, however the actual rotor selected may be larger in size, depending on the model of WTG selected. Similarly tower heights vary across a range of WTG models, and while it is expected that the selected model would have a tower (hub) height of between 125 and 166 m, this may vary.

Figure 4-6 below displays a picture of the 200 m tall WTGs installed at Sapphire Wind Farm, detailing the component parts.

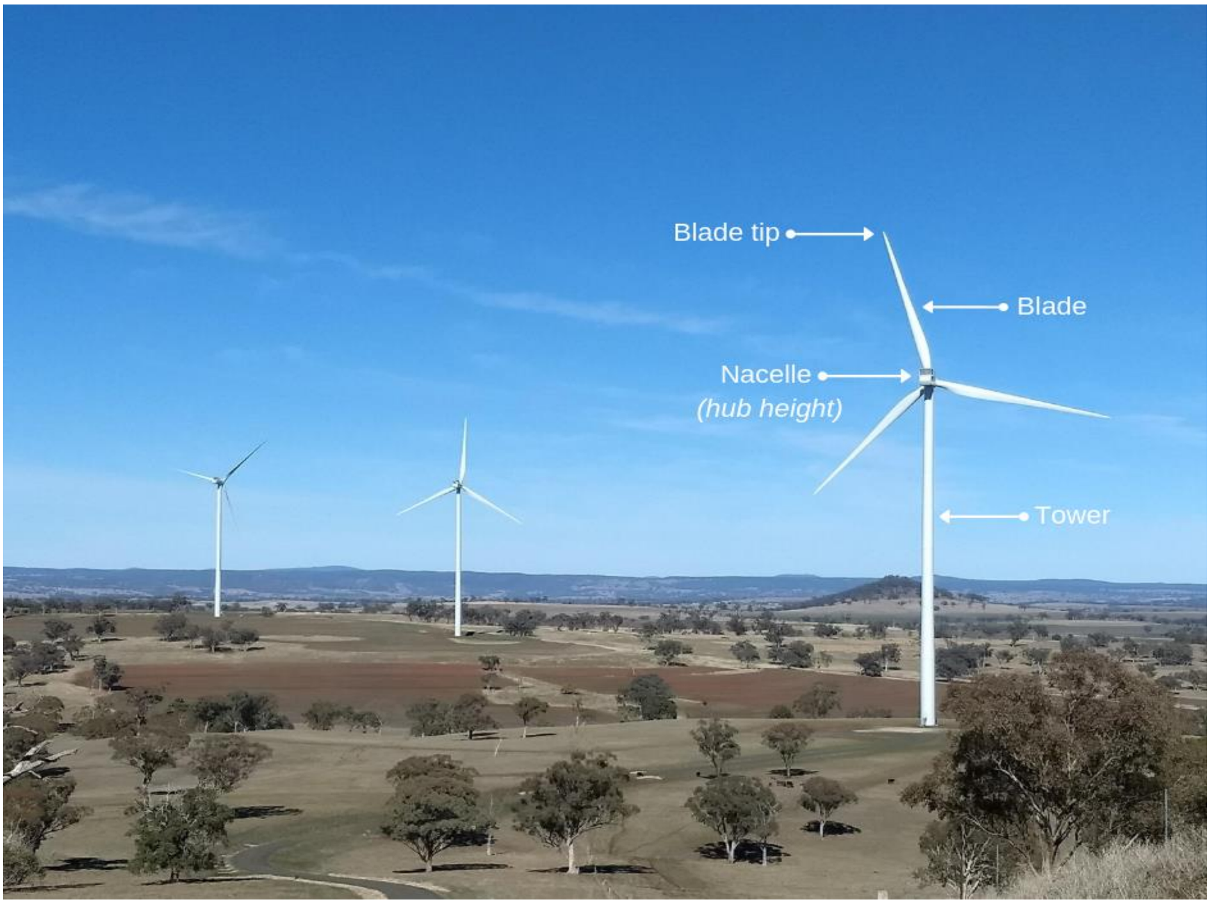


Figure 4-6: Components of a WTG as shown at Sapphire Wind Farm

4.2.1 Foundations

Two types of foundation for the WTGs will be considered pending geotechnical investigation of the ground conditions across the Project Site. The following examples are based on a typical foundation design, but final WTG selection and geological surveys will dictate which is to be used.

Slab (gravity) foundations involve the excavation of ground material to a depth of approximately 2.5 m (subject to geotechnical surveys). Once poured and cured, a foundation is backfilled with material excavated from the same location with any excess fill material made available for reuse on-site. Slab foundations involve the installation of shuttering and steel reinforcement, followed by the pouring of concrete (refer to Figure 4-7 (left) for an example of a conventional gravity foundation).

If slab plus rock anchor foundations are required, the construction of the foundation for each WTG would involve the excavation ground material plus drilling of rock anchor piles to a depth determined by geotechnical surveys. Refer to Figure 4-7 (right) for an example of a conventional rock anchor foundation).

Figure 4-7: Typical gravity (left) and rock anchor (right) foundations

It is necessary for detailed geotechnical surveys to be carried out pre-construction to determine the foundation type per WTG. It is feasible that more than one type of WTG foundation may be required for the Project, which will be determined during the detailed design phase following the assessment of the individual WTG locations. New WTGs are continually entering the market and it is possible that variations to these conventional foundation designs could occur prior to final WTG selection.

The excavation required for both types of foundations will be approximately 27m x 27m and would be undertaken by mechanical equipment and may require low-level blasting where firm rock is encountered. Blasting would be undertaken by qualified personnel subject to relevant statutory requirements and approvals, and in accordance with relevant guidelines for blasting in proximity to neighbouring dwellings.

4.2.2 Towers

The supporting tower structure of a WTG is typically comprised of a reducing cylindrical tower made out of either a welded steel shell or a concrete steel hybrid, fitted with an internal ladder and lift. A range of tower heights are under consideration with the final selection subject to competitive tender. Typically, towers to accommodate the proposed maximum blade tip height of 250 m have base diameters of 6 m and 3 m at the top. Conventional towers will typically be manufactured and transported to the Project Site in four to seven sections for on-site assembly (refer to Figure 4-8 or an example of a typical WTG tower including nacelle). Atop the tower sits the nacelle to which the hub is mounted, and the three blades are attached to the hub. For the purposes of this EIS, the centre point of the hub height is considered equal to the tower height. The Project is designed to include a hub height of 125 – 166 m.

Figure 4-8: Example of a WTG tower with the nacelle mounted at Sapphire Wind Farm

4.2.3 Nacelle

The nacelle is the housing constructed of steel and fibreglass (refer to Figure 4-9 for an example of a typical nacelle) that is mounted on top of the tower and is typically around 15 – 18 m long, 4.5 m high and 4.5 m wide (depending on the WTG model). It encloses the gearbox, generator, transformers (model dependant), motors, brakes, electronic components, wiring and hydraulic and lubricating oil systems. Weather monitoring equipment located on top of the nacelle will provide data on wind speed and direction for the automatic operation of the WTG. In consultation with Civil Aviation Safety Authority (CASA), a vertical obstruction assessment will be undertaken to determine if aviation hazard lights are required (which can be fitted to the top of the nacelle).

Figure 4-9: Example of a nacelle for a 3.6 MW WTG at Sapphire Wind Farm

4.2.4 Rotor

The WTG rotor drives the generator within the nacelle producing electrical output. In general, a larger rotor enables greater generation capacity, however site-specific wind conditions influence the rotor selected for installation at any given wind farm.

WTGs of the size considered in this EIS begin to generate energy at wind speeds in the order of 3.5 to 4 metres per second (m/s) (13 kilometres per hour (kph)) and shut down (for safety reasons) in wind speeds greater than 25 m/s (90 kph). WTG blades are typically made from glass fibre reinforced with epoxy or plastic attached to a steel hub and include lightning rods for the entire length of the blade. The blades typically rotate at about 12 revolutions per minute (rpm) at low wind speeds and up to 18 rpm at higher wind speeds.

The Project is designed to include rotors of approximately 170 m with an individual swept area of approximately 22,698 m^2. (i.e. 2,201,706 m^2 for 97 WTGs of rotors this diameter). However, it is possible that larger rotors will be required depending on the specifications of blades on the market at the time of construction. If so the selected WTGs would remain within the 250 m tip height envelope and overall swept area for the Project would not exceed the limit identified and assessed in Table 4-1, which would be achieved with the installation of fewer WTGs.

4.2.5 Blades

Blade lengths of 73.5 m in a single piece construction are currently in production, however longer blades can be expected as WTG technology develops further and especially with the introduction of multi-piece blade construction. Multi-piece blades will greatly improve transport logistics and reduce traffic and transport impacts. Whether the Project installs single or multi-piece blades is dependent on detailed design and the Project’s engineering and procurement processes which will not be undertaken until after the Project would receive Development Consent. To allow for the advancements in available blade lengths within the assessed impacts, this EIS has used a blade and hub section, that makes a rotor of 170 m in diameter. An example of a single piece blade at the Sapphire Wind Farm is shown in Figure 4-10.

Uppermost blade tip comprises the highest point of the WTG when in a vertical position. Recent advances in WTG technology have meant that WTGs with blade tip heights of 200 m are currently operating in NSW with larger WTGs of 250 m available for the market. Lowermost blade tip refers to the height between the ground and the lowest point of rotor when in operation. This EIS conservatively assumes a lowermost blade clearance of 40 m above the ground based on a 170 m rotor installed on a 125 m tower.

Figure 4-10: A single piece blade approximately 62 m long at Sapphire Wind Farm

4.2.6 Generator Transformer

WTGs produce electricity at low voltage which is then stepped up to medium voltage (33 kV or greater) by a transformer located in either the nacelle, within the base of the tower, or adjacent to the base of the tower on a concrete pad. Figure 4-11 **s**hows an example of a transformer located outside of the tower. The footprint of the transformer is marginal as it would sit on the WTG footing and/or the hardstand assembly area.

Figure 4-11: Example of a generator transformer located outside of the tower at Boco Rock wind farm

The generator transformer may be oil-filled or a dry type depending on the WTG. Where oil-filled transformers are used, appropriate measures will be incorporated to prevent any oil loss and contain any spill within a bunded area. The volume of oil used for generator transformers is in the order of 1,000 litres (L). The output from each of the WTGs will be directed via medium voltage (33 kV or greater) underground and overhead transmission lines that link to the Substations or ESF.

4.3 Energy Storage Facility

An ESF forms part of the Project which would consist of infrastructure designed to store and discharge energy. Storage of energy can add significant benefits to renewable generation because it allows for the dispatch of energy in accordance with market demand and overcomes potential issues associated with intermittency of output. The electrical capacity of the ESF has been considered nominally as 150 MWh as an indicative capacity but it is not intended as an upper limit.

The technology used (i.e. the type of energy storage) is not yet decided and the most commercially suitable type will be deployed for use in the Project depending on the detailed design and financial modelling process. A range of technologies have been considered, including lithium-ion, lead acid, sodium sulphur, sodium or nickel hydride, electrochemical technology (i.e. flow batteries), cryogenic storage and compressed air.

The ESF will consist of buildings, shipping containers, or other infrastructure and will connect to the WTGs and Substations via underground and/or overhead cables.

Possible stand-alone locations of the ESF have been identified on Figure 1-2 and assessed within this EIS. One or more of these locations may be utilised for optimal construction and operation of the Project. Section 8.6 includes an assessment of hazards and risks associated with the Project, including ESF technology. Security fencing, lighting and a 20 m asset protection zone (APZ) will be incorporated into the final design layout if battery-based storage technology is used.

4.4 Ancillary Infrastructure

Ancillary Infrastructure refers to all wind farm infrastructure with the exception of WTGs and ESF, including Substations, O&M compounds (including offices and car park), underground and overhead electricity transmission lines, permanent Meteorological Masts, hardstands and Internal Roads.

4.4.1 Substations

Substation infrastructure will be required to collect the internal electrical reticulation to increase the voltage for transmission to connect to the grid. This may be constructed as a stand-alone facility or as a combined facility co-located with other compounds at any or each of the locations shown in Figure 1-2. It will include electrical componentry and buildings designed to appropriate industry standards and will include security systems to exclude people and livestock such as fencing and external lighting. The Substation may be powered by a low voltage distribution line from the local distribution network if feasible. The electrical infrastructure has been designed to minimise the visual impact of the Project by siting the infrastructure away from residences and surrounding public viewpoints as far as practical whilst maintaining the practical and operational needs of the infrastructure.

Substation locations have been chosen to minimise access distance and electrical losses, and to reduce their visibility from surrounding public viewpoints (see Figure 1-2) and optionality is included in the design because the Substations configuration, location and final layout will be developed in consultation with the Network Service Provider (TransGrid) during detailed design (although some consultation has occurred already). A detailed electrical design will be undertaken by an appointed contractor and delivered in accordance with relevant electrical standards in consultation with

TransGrid and other relevant authorities. Three potential locations have been identified for the Substations, which are at a minimum distance of 2 km from any nearby residences. Following construction, and if warranted, raised earthwork perimeters and / or small areas of native tree planting may be undertaken to screen any parts of the Substations that are visible from sensitive receptors based on the results of the relevant impact assessment. Emergency backup power for the Substations will be supplied by an on-site diesel generator and/or batteries to maintain network communications and electrical protection capability.

The Substations will occupy an area approximately 220 m by 160 m or 3.52 ha. The potential locations assessed for the Substations have considered the provision for a 20 m APZ surrounding the infrastructure and a 3 m high security fence.

The typical substation arrangement will include step-up transformers, an array of cable marshalling, busbars, switchgear and protection, various voltage and current transformers, operation and facilities building with parking, communication facilities and tower, diesel generator, lighting, a buried earth grid, lightning masts, power conditioning equipment, a reactive power control system, and network support equipment as agreed with TransGrid. The Substations will require a standalone power supply from either the local 11 kV distribution network, or an on-site generator. The ground surface within the Substations enclosure will be covered partly with a layer of crushed rock and partly by concrete slabs. As the transformer(s) may each contain upwards of 50,000 L of oil, provision will be made in the design for primary and secondary containment of any oil that may leak or spill from the transformers or associated components(potential impacts are discussed further in Section 8.9.3 and Section 8.10.3). This would involve constructed concrete bunds around each transformer and a spill oil retention basin or oil / water separator outside the Substations compound.

4.4.2 Operations and Maintenance Compound

One or more O&M compounds will be established for the day to day operation of the Project and would take up an area of approximately 100 x 100 m or 1 ha (at the indicative locations shown in Figure 1-2 as ‘Site Compounds’). Three potential locations for the compounds have been identified in Figure 1-2, with construction access only via Twelve Mile Road (with exceptional considerations discussed in Section 4.1.2) and operational access from Uungula Road or Ilgingery Road. Each O&M compound may include lay down areas, site operations facilities and services buildings, workshop, storage, parking and other facilities for operations staff (see Figure 4-12 and Figure 4-13; Figure 4-14 shows an indicative layout). The buildings of the operations compound will house office space, toilet, kitchen, communications equipment, meeting room and routine maintenance stores.

Figure 4-12: Sapphire Wind Farm O&M compound (foreground) shown in front of the 33 kV substation (aerial view)

Figure 4-13: Sapphire Wind Farm O&M compound ground level view

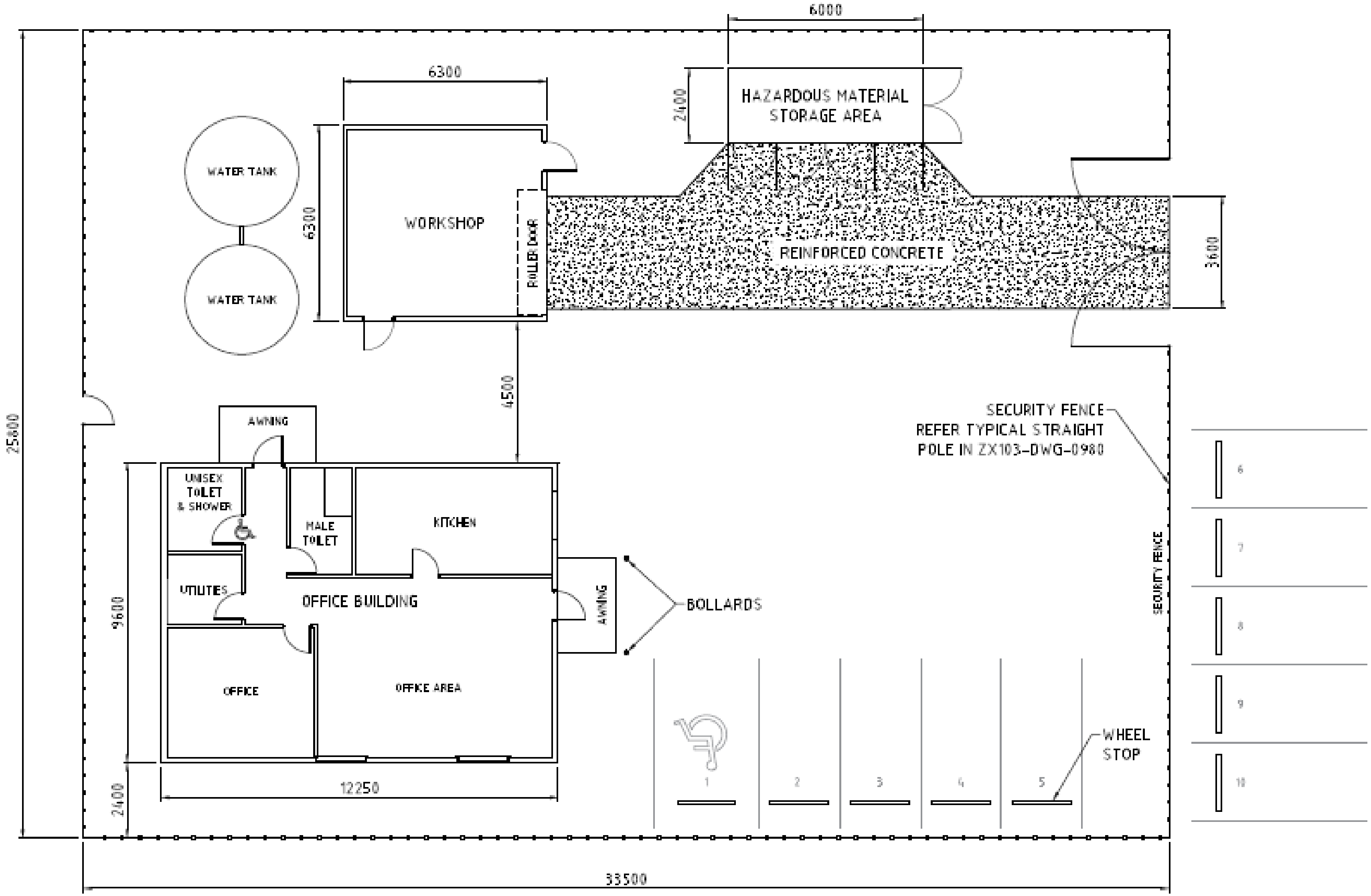


Figure 4-14: Typical O&M facility layout

4.4.3 Transmission Lines

A series of underground and overground transmission lines are proposed to transmit electricity generated by the WTGs with the 330 kV transmission line running in approximately east-west located within the northern part of the Project Site as shown in Figure 1-1. The preliminary electrical layout includes both underground and overhead reticulation connecting the WTGs, the ESF and Substations to the existing transmission network. The electricity produced by each WTG would be transformed from low voltage to medium voltage (33 kV or greater) by a transformer generally located within or adjacent to each WTG. The internal electrical network will likely comprise 33 kV circuits between the WTGs, the ESF and Substations, and a 132 kV or 330 kV transmission line between the other Substations. Underground transmission lines and control cables will be installed below the ground surface to conduct electricity between the WTGs, the ESF and the Substations.

Sections of the proposed overhead transmission lines may need to be placed underground subject to local conditions and conversely sections of the proposed underground transmission lines may need to be placed overhead subject to local conditions. The typical easements for the various overhead and underground lines vary depending on voltage and are shown in Table 4-6. Voltages ranging from 33 kV to 330 kV may be constructed in single or double-circuit configurations depending on the WTG selected for the Project and any staging considerations.

4.4.3.1 Overhead Transmission Lines

Overhead transmission lines are approximately 50 m in height, with insulators and a typical span length as shown in Table 4-6. The Project is working closely with landowners to ensure impacts of overhead transmission lines are mitigated where possible. The required easement width may vary due to terrain and alignment, such as to accommodate sharp changes in direction. Figure 4-15 and Figure 4-16 show the typical overhead transmission line configurations which could be constructed for the Project.

Table 4-6: Indicative transmission line specifications

Voltage	Approximate Easement Width	Approximate Height of Pole	Typical Span Distance (Pole to Pole)
330 kV	60 m	35-50 m	200 – 300 m
132 kV	45 m	35-50 m	200 – 300 m
66 kV	30 m	30 m	150 – 250 m
33 kV	30 m	20 m	150 m

Figure 4-15: Double-circuit overhead 33 kV transmission line

Figure 4-16: Example of double-circuit overhead 330 kV transmission line adjacent to a new single-pole substation tie-in

New transmission poles will be predominately of timber, steel or concrete construction with horizontal line posts that would be porcelain or polymer. Steel poles are typically used in areas of difficult terrain as they offer some advantages in steep or rocky areas. The transmission poles will be placed up to 300 m apart, with the final details of pole numbers, spacing and location to be determined during the detailed design phase.

4.4.3.2 Underground Transmission Lines

The underground electrical cables will follow the general layout of the Internal Roads because by their nature they link all the Project elements together (like the Internal Roads), however they may not be directly adjacent to the Internal Roads due to design and construction efficiency. They will be located during the period following engineering, procurement, and construction (EPC) contract tendering and award when detailed design is undertaken according to the micro-siting criteria. Underground cables will be laid in accordance with the relevant standards and specifications at the time of construction, with the typical depth over 0.9 m as shown in Figure 4-17. The cables will be trenched or dug, installed and backfilled (refer to Figure 4-18).

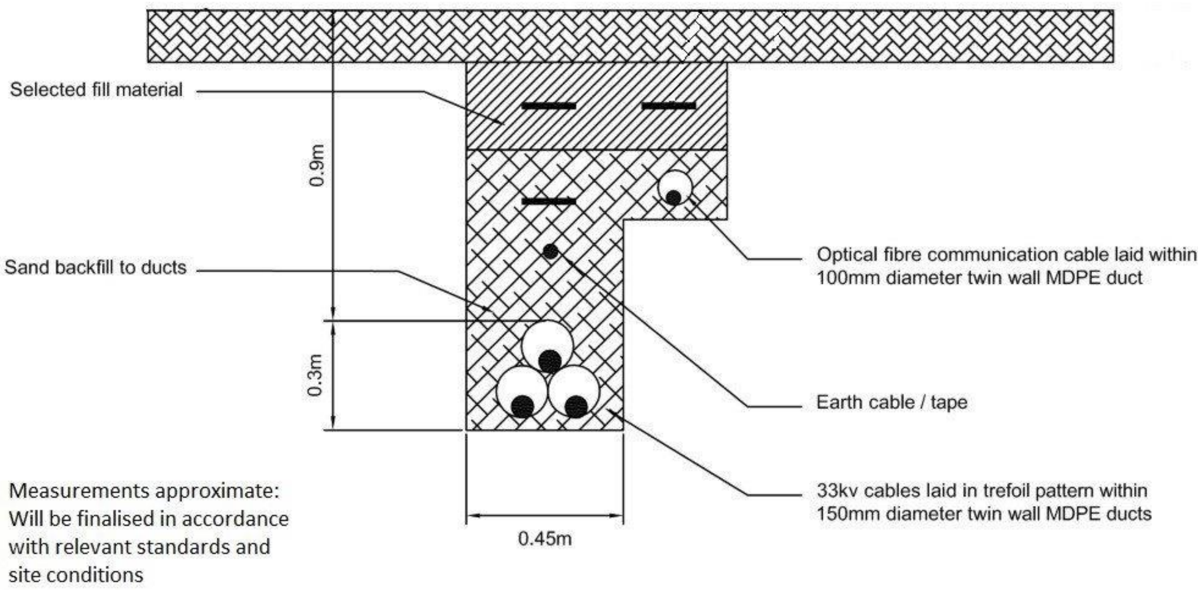


Figure 4-17: Indicative cable trench design[3]

[3] Indicative design only.

Figure 4-18: Laying underground transmission line within the road network

For the purposes of this EIS, an electrical design has been prepared which considers the worst-case transmission line impacts of the Project. This EIS is based on the largest likely separation distance between the Substations and the existing 330 kV transmission line and therefore the longest likely 330 kV overhead easement. Similarly, the underground Project circuitry has been conservatively estimated with the longest likely lengths of overhead line connecting the WTG circuits to the Substations.

The final electrical layout will minimise vegetation clearing and avoid potential erosion and heritage sites, and will also depend on the ease of excavation, ground stability and cost. Location markers may be placed along the route of the underground transmission lines, if agreed by the participating landowners, for safety reasons. Placement of these transmission lines below ground will result in minimal visual impact once the ground has been rehabilitated, if appropriate.

Underground transmission cables (including control cables and earthing (refer section below)) crossings of watercourses will be designed and constructed considering:

- Managing Urban Stormwater: Soils and Construction (Landcom, 2004) manual, or its latest version;
- Controlled activities on waterfront land – Guidelines for watercourse crossings on waterfront land (DPI Water, 2012); and
- Controlled Activities: Guidelines for laying pipes and cables in watercourses on waterfront land (DPI Water, 2012).

4.4.3.3 Control Cables and Earthing

Computerised controls within and between the WTGs, the ESF, Substations and the O&M compound(s) automatically control the Project. Recording systems will monitor wind conditions and energy output at each of the WTGs and ESF. Remote 24 hr monitoring and control of the Project will also be employed. Control cables will consist of optic fibre, twisted pair or multi-core cable and will be located underground within the clusters of WTGs or attached to the overhead transmission lines. No additional impact is considered as the cabling will be paired with the transmission lines. The installation of buried earthing conductors and electrodes will also be required in the vicinity of the WTGs, the ESF, Substations and the O&M compound(s).

4.4.4 Permanent Meteorological Masts

Approximately six permanent Meteorological Masts, up to hub height of the WTGs, will be installed on-site. The purpose of these masts is to provide necessary information on the performance monitoring of the WTGs. The permanent Meteorological Masts would be of a guyed, narrow lattice or tubular steel design with concrete footings of approximately 1 m^2 for the mast and guy wires. Guy wires may extend beyond 100 m from the base of the Meteorological Mast. Figure 4-19 shows both typical Meteorological Masts designs.

Figure 4-19: Tubular (left) and lattice (right) wind monitoring masts

Locations for these masts are yet to be determined and will be influenced by the final WTG selection. For functional reasons they must be near to a selected few WTGs but separated from those WTGs by a distance allowing accurate wind measurements. To overcome those separation requirements and select locations for the Meteorological Masts that provide the functionality required the masts and the guy wires that secure them may need to be located outside of the Development Corridor, however they will remain within the Project Site. The mast locations will be identified on the post-Development Consent plans provided to the Secretary (whether prior to, or during construction of the Project), with coordinates also provided to the relevant aviation authorities prior to their erection, and 'as built' locations confirmed to those authorities within one month of the installation of any permanent Meteorological Mast.

Permanent Meteorological Masts will require a low voltage cable connection for power and a communications cable to be laid. The trench required for this will be approximately 1 m in width and would come directly from the closest WTG.

4.4.5 Hardstands

Hardstands are required adjacent to each WTG location for the assembly, erection, maintenance, repowering and/or decommissioning of a WTG. Indicative hardstand dimensions are 50 m x 40 m, however, is likely to vary dependent on detailed design, topography, construction methods and chosen WTGs. Hardstands will be surfaced with pavement material to required load-bearing specifications, maintained throughout the construction and operational life of the Project and used principally for construction and periodic maintenance of the Project. Surrounding the hardstand is an area of disturbance included in the Development Footprint which is not a hardstand area but will be used for WTG component laydown and crane structure assembly (among other WTG erection and construction related activities) as well as cut and fill. Figure 4-20 shows a typical hardstand area adjacent to a WTG footing.

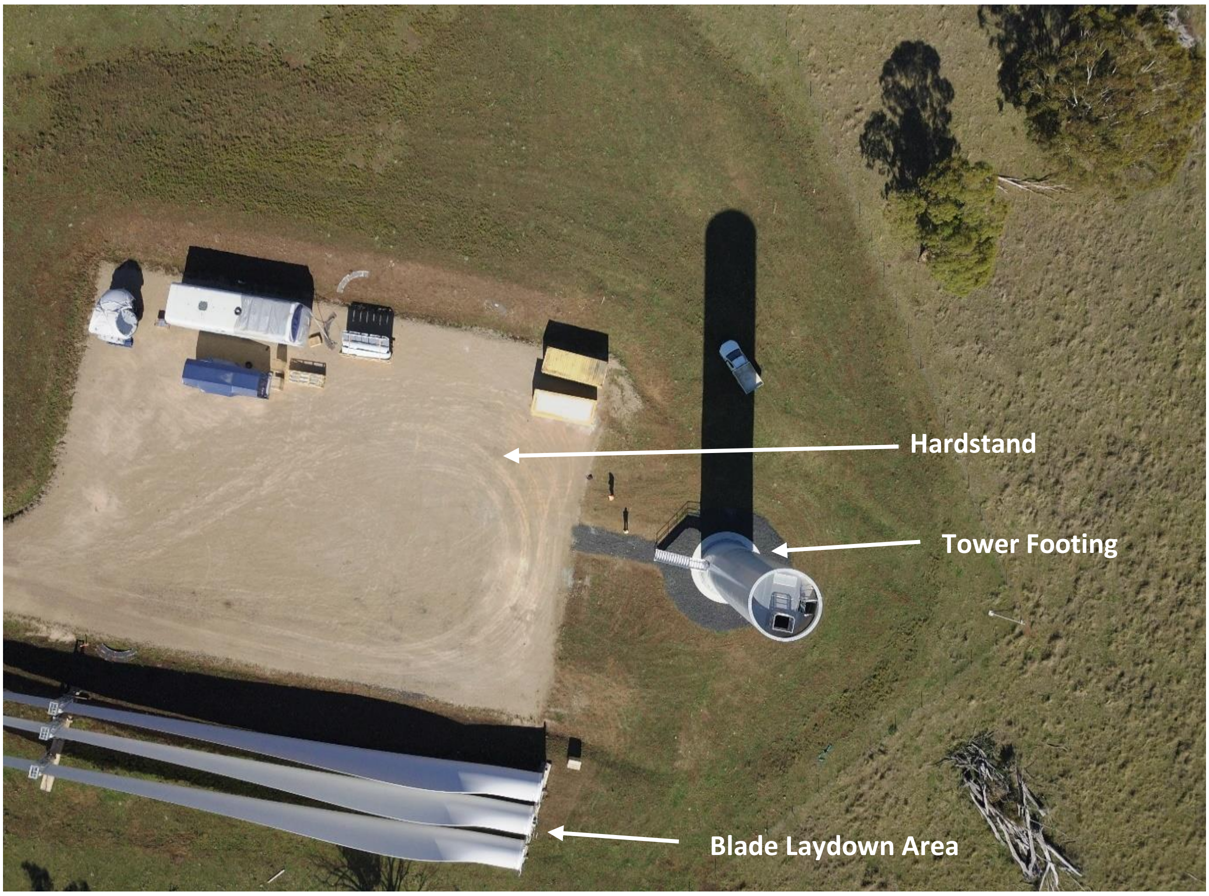


Figure 4-20: Hardstand, tower footing and blade laydown area at Sapphire Wind Farm

4.4.6 Internal Roads

Internal Roads will be established within the Project Site for the construction, operation, repowering and/or decommissioning of the Project, from the public road access locations, WTGs, the ESF, Substations and other permanent and Temporary Facilities. Internal Roads have been planned to follow existing farm tracks where practicable and have an approximate pavement width of 6 m, in addition to an adjacent drain and cut and fill batters. All Internal Roads will require a full or partial upgrade to accommodate the construction traffic loads, as well as for maintenance purposes during operation. Access to the Project Site on Project roads would be restricted from public access. The indicative internal road network is approximately 90 km in length (refer to Figure 1-2).

Construction of the internal road network will require earthworks for safely transporting Project components into position. Preliminary civil engineering designs have been created to inform the area-based impact assessments (such as Biodiversity: Section 8.4). Detailed civil engineering designs will be prepared following contract award to the chosen EPC contractor for the Internal Roads network, cut and fill batters and embankments to stabilise the Internal Roads as well as drainage structures and suitable erosion and sediments control structures. Some steep sections of Internal Roads may need to be surfaced with asphalt to enable haulage of heavy WTG components.

Small culverts may also be required to be constructed where internal access roads cross streams. The location of the proposed waterway crossings are set out in (Appendix E).

Detailed design and construction requirements of the road crossings of waterways (where required) will be undertaken post-Development Consent in consideration of:

- Managing Urban Stormwater: Soils and Construction (Landcom, 2004) manual, or its latest version;
- Policy and Guidelines for Fish Friendly Waterway Crossings (NSW DPI, 2004); and
- Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (Fairfull and Witheridge, 2003).

4.4.7 Other Permanent Ancillary Infrastructure

4.4.7.1 Utility Services

The Project will be connected to TransGrid's transmission network and when not generating will draw a minor amount of electricity from the grid. Backup and emergency power at the Substations may be supplied by a local 11 kV distribution line, on-site batteries and/or a standalone diesel generator. Two separate and independent telephone communications facilities (optic fibre and microwave) will be required to be installed between the Substations as required by the AEMO to enable safe remote monitoring and control of the Project. Mobile telephone coverage is available on most of the ridgelines and plateaus with limited or no service available on the majority of the valley floor. Although the Project will not rely on this form of communication, it can be assumed that members of the construction, operation and maintenance teams will communicate using both mobile telephones and radios.

Operational water requirements will be provided to the proposed facilities and auxiliary services building from a storage tank designed to collect water from roof drainage and augmented by potable water delivered by tankers. An approved septic system or composting system will be installed to treat minor quantities of wastewater, subject to securing the relevant authorisation. The Proponent will be responsible for classification and removal of all other wastes from the Project Site to an approved landfill facility.

4.4.7.2 Signage

Traffic signage required as part of traffic safety during construction will be installed by the contractor, in compliance with relevant regulations and in accordance with any permits obtained for traffic management.

Signage will be erected at critical locations from the outset of construction, directing all vehicles associated with the construction site to the Project Site office. Additional signage would be located close to the Project Site, providing information about the Project, the companies involved and essential safety information and telephone numbers.

Consultation with Dubbo Regional Council and Transport for NSW will be initiated to determine final signage locations.

4.5 Temporary Facilities

Temporary Facilities will consist of site offices and compounds, rock crushing facilities, concrete or asphalt batching plants, stockpiles and materials storage compounds, Temporary Field Laydown Areas, minor 'work front' construction access roads and temporary Meteorological Masts. The location of Temporary Facilities is described in the following subsections.

All temporary facility sites will be rehabilitated once they are no longer required in accordance with detailed measures to be defined within the Project BMP.

4.5.1 Site Offices and Compounds

The construction phase will require temporary infrastructure such as portable field offices, toilet facilities and parking bays within the temporary construction compound locations. Arrangements will be made for power and communications at the site office during the construction period. Temporary construction compounds will be typical of that used at construction sites; noting they will not include accommodation facilities. Three potential locations for construction compounds have been initially identified in Figure 1-2, all with access directly from Twelve Mile Road, Uungula Road or Ilgingery Road.

Alternative locations may be sought subject to project staging detailed design and construction programming. If alternative locations for any of the temporary site offices and compounds are sought, then the selection criteria for Temporary Facilities will be considered to determine suitable locations. The final locations will be determined in accordance with the Development Consent conditions and subsequent management plans and shown on the Final Layout Plans.

Main temporary site office facilities will be approximately 75 x 75 m located within the construction compound area of approximately 150 m by 200 m, a combined area of approximately 3 ha (an example layout is shown in Figure 4-21). The area will be fully fenced with sufficient access to allow vehicle movement, storage of materials and containers, and office facilities. An area approximately 100 m x 100 m will be retained for permanent use during the life of the Project as an operations compound which will include a site office, workshop, storage, parking and facilities for operational staff. Building fit-out will include power, lighting, air-conditioning, security, fire detection, and communication systems as required.

A small portable field office (or offices) may be required at the main site entry for a brief period at the commencement of construction to act as a temporary facility until the main site entry intersection on Twelve Mile Road is complete, and until the main internal access road is established to link that entry point and the temporary construction compound further south east into the Project Site. The same may be required on the northern side of Twelve Mile Road when the intersection and access road are being constructed between Twelve Mile Road and the existing 330 kV transmission lines. The timing of constructing the intersection and main access roads on either side of Twelve Mile Road may or may not be concurrent depending on the detailed design and construction programming. Similarly, a small portable field office (or offices) may be required adjacent to the Substations, should contracting arrangements dictate that two (or more) main contractors are appointed to build the wind farm infrastructure separate to the Substations. Furthermore, portable temporary offices and amenities will be required at construction work fronts. These areas are not shown on Figure 1-2 as their location is uncertain however they will remain within the Development Corridor. Therefore, flexibility is sought to allow for both portable field offices to be established.

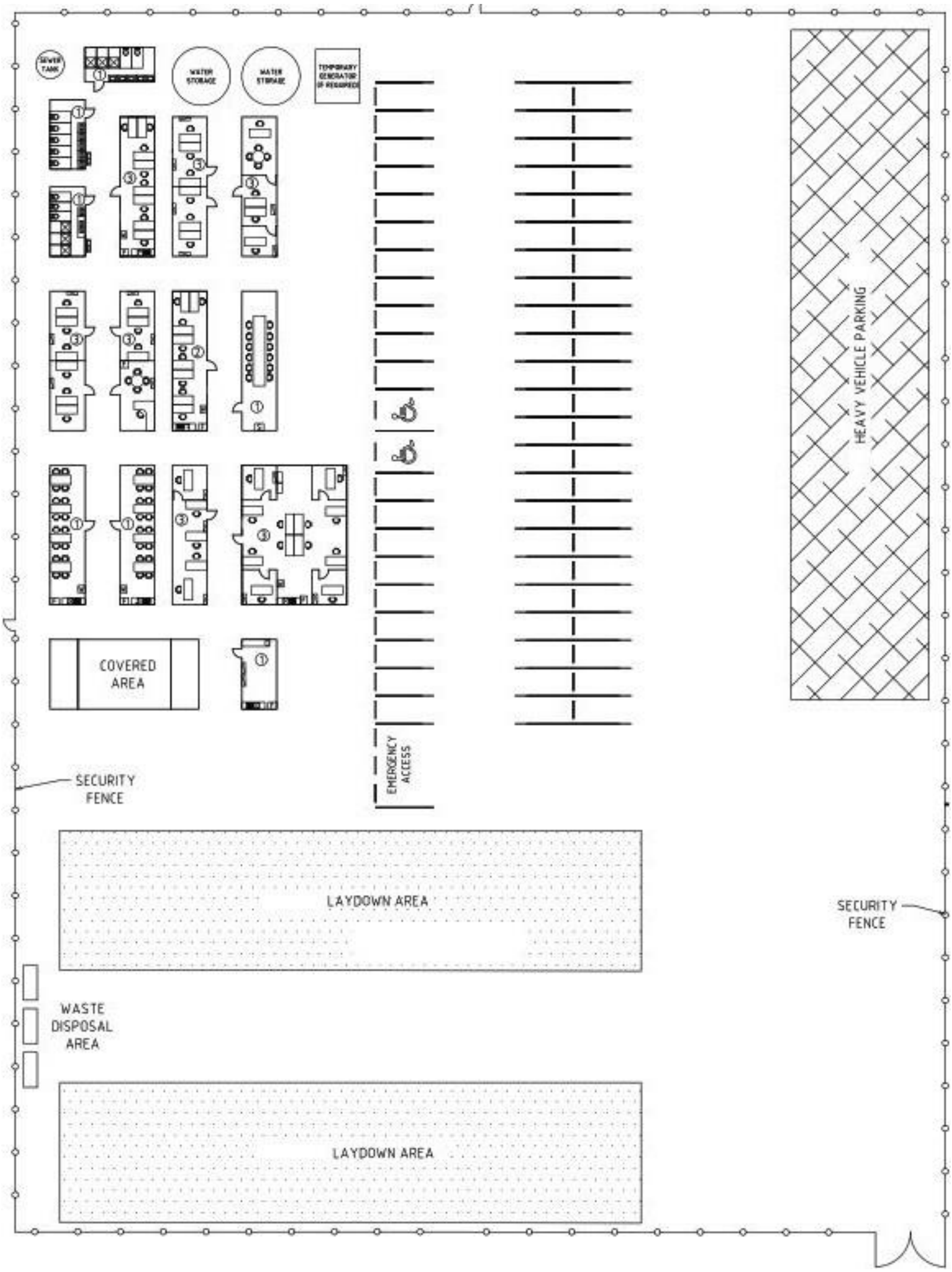


Figure 4-21: Example wind farm construction site offices and compounds

4.5.2 Rock Crushing and Concrete or Asphalt Batching Plants

Temporary rock crushing and concrete or asphalt batching plants are proposed to process aggregate and concrete for the WTG foundations, electrical infrastructure and Internal Roads, as well as asphalt if required for Internal Roads. Following detailed geotechnical site investigations and the final Project layout, accurate estimates of materials to be processed by these facilities will be calculated. If the extraction and processing thresholds exceed Schedule 1 of the *Protection of the Environment Operations Act 1997* (POEO Act), an Environmental Protection Licence (EPL) will be obtained from the EPA for the operation of rock crushing or concrete batching facilities.

A typical on-site concrete batching plant facility would occupy an area of approximately 100 m by 100 m and likely consist of a trailer-mounted concrete mixer, cement bins, sand and aggregate stockpiles and a storage container for various equipment and tools. Similarly, an on-site asphalt batching plant facility would occupy an area of approximately 50 m by 100 m and likely consist of a plug-mill mixing chamber, aggregate dryer, bitumen tanks, aggregate bins and a storage container for various equipment and tools. A rock crusher would occupy an area of approximately 50 m by 100 m and consist of a tracked mobile crushing unit, conveyor belts, feeder and engine. Each facility is sized for the use of front-end loaders, delivery of materials and entry and exit of vehicles and have sufficient storage are for materials for five days batching.

Suitable locations for such facilities are not identified as they will be dependent on detailed design and construction programming. Their locations will be selected in accordance with the Development Consent, giving consideration to noise, amenity, biodiversity, traffic management and heritage. Specific operational requirements have been identified in the relevant EA and further managed via the construction environmental management plan. Some temporary rock crushing may occur throughout the Project Site using mobile plant if required following excavation of rock material to reuse in the immediate area and maximise construction efficiency.

4.5.3 Stockpiles and Materials Storage Compounds

Stockpiling of materials will be undertaken to maximise construction efficiencies and minimise waste being exported from the Project Site. Stockpiles will be established and utilised adjacent to excavations for WTG foundations, Internal Roads, compounds and laydown areas for the duration of construction. Stockpile and storage requirements have been identified in the relevant EA and are further managed via the construction phase environmental management documentation and plans. Fuel is typically stored in double bunded trans tank at the construction compound and trucked to plant in the field.

4.5.4 Laydown Areas

Laydown areas may be required adjacent to WTG locations, site compounds and Internal Roads for the storage and assembly of WTG components and equipment. The use of laydown areas can reduce the logistical complications of just-in-time deliveries and reduce traffic impacts by de-coupling the WTG component delivery timeframe from the erection schedule. Hardstands and crane or equipment assembly areas will be used wherever possible to minimise impacts, however in some instances separate laydown areas will be required.

Temporary Field Laydown Areas are those where components may be placed on the ground in preparation for moving or relocating around the Project Site. These are not yet identified and will be dependent on detailed design and construction programming. They will be selected to best avoid environmental constraints identified in this EIS and will occur within the Development Corridor.

4.5.5 Minor 'Work Front' Construction Access Roads

Construction roads, tracks, or even Light Vehicle movements over farmland areas, may be required to facilitate some parts off the Project including, for example, the erection of overhead transmission lines, work front construction and maintaining environmental management measures. Construction roads that are not required for the ongoing operation and maintenance works of the Project they will be removed and rehabilitated on completion of the construction phase, and in accordance with landowner preferences and environmental controls.

4.5.6 Temporary Meteorological Masts

There are currently three temporary Meteorological Masts installed within the Project Site which are being used to collect data for the Project. Two are 60 m guyed tubular masts and the third is a 100 m guyed narrow lattice mast. It is expected that additional temporary Meteorological Masts will be installed within the Project Site prior to the start of construction of the Project. The Proponent is seeking approval for the existing and future temporary masts installed at the Project Site as part of the Development Consent.

Up to two temporary Meteorological Masts, up to hub height of the WTGs, will be installed for each permanent Meteorological Mast (approximately 12 in total) during the construction period to calibrate and verify the data collected from the permanent Meteorological Masts. These will be installed at locations within the Project Site, usually (but not always) at a selection of proposed WTG locations ahead of construction. Final locations will be determined during detailed design and because they are usually located at proposed WTG locations, they are subject to the WTG micro-siting process. They are typically removed when construction of the WTG at that location is commenced.

Temporary Meteorological Masts will require a low voltage cable connection for power and a communications cable to be laid. The trench required for this will be approximately 1 m in width and would come directly from the closest WTG.

4.6 Project Phases

This section provides a description of the various phases of the Project lifecycle which would commence with the receipt of the Development Consent.

4.6.1 Pre-Construction

4.6.1.1 Detailed Design and Contract Development

Once all required permits and approvals have been obtained, secondary approvals will be acted upon including approval of the EMS and associated management plans, and application for an EPL and other relevant authorisations. A tender process will be undertaken in parallel to procure bids for the supply and installation of WTGs and the ESF, as well as design and construction of the Ancillary Infrastructure and Temporary Facilities. This process will consider each tenderer's record of environmental management and compliance performance to ensure that they are able to achieve the required specification of works.

Once the preferred contractors are selected, final construction and procurement contracts will be negotiated. The Project EMS, approved management plans and other permits or licences will be incorporated into the contract specifications for the construction works and equipment supply to ensure the Project is delivered in accordance with the Development Consent. The selected contractor will be required to adhere to the EMS, associated management plans and other permits or licences in addressing their component of the Project works.

4.6.1.2 Pre-construction Minor Works

Prior to the commencement of Construction, Pre-construction Minor Works will take place to further inform the detailed design and prepare the Project Site for construction and will involve the establishment of some Temporary Facilities. Pre-construction Minor Works include the following activities:

- Surveys;

- Building/road dilapidation surveys;
- Investigative drilling, excavation or salvage;
- Minor clearing or translocation of native vegetation;
- Establishing temporary site office and compounds;
- Installation of environmental impact mitigation measures, fencing, enabling works, and Meteorological Masts;
- Flora and fauna investigations and pre-clearing surveys, inspections, specific habitat feature removal, and relocation;
- Establishing Project Site access points, minor access roads and minor adjustments to services/utilities, signage etc. including associated vegetation removal and heritage artefact salvage;
- Upgrading Twelve Mile Road and Project Site entries; and
- Intersection and road upgrades on the public road network.

4.6.2 Final Investigation Decision

When all Project contracts are agreed, and conditions precedents (which may include to conditions in contracts, the Development Consent, and finance arrangements) are satisfied, a Final Investment Decision will be made. At this point, all contracts will be contemporaneously executed, and the Project will move towards the construction phase.

During this period, site mobilisation activities may commence (or continue if already commenced under Pre-construction Minor Works) and extensive detailed design activities commence.

4.6.3 Construction Works

Construction works will commence following provision of detailed design inputs, which may be staged. Construction includes all physical works to enable the operation, including, but not limited to, the construction and installation of WTGs, construction and installation of the ESF, construction of Ancillary Infrastructure and establishment or construction of any Temporary Facilities which were not already established as part of the Pre-construction Minor Works.

4.6.3.1 Working Hours

Unless the Secretary approves otherwise, the Project will only undertake construction or decommissioning activities between:

- 7 am to 6 pm Monday to Friday; and

- 8 am to 1 pm Saturdays.

Notwithstanding works undertaken outside these hours may occur where the activity is inaudible, for emergency works, delivery of certain materials, in accordance with *Environmental Planning and Assessment (COVID-19 Development – Construction Work Days) Order 2020* or where agreement from the Secretary has been provided.

Certain activities will require work to be conducted outside normal work hours to prevent damage to concrete tower bases and trenches, to reduce the safety risk of open trenches and to reduce the risk of tower self-oscillation. Some examples of these activities include:

- **Concrete Pours:** Concrete work is to be carried out as a continuous process (once bases are prepared) for some 8-12 hours per base. This activity includes the operation of the concrete/asphalt batching plants. Weather conditions play a major role; the concrete can only be placed at temperatures between 5 and 35°C (specification) and not during rain periods. Once bases have been prepared it is essential that concrete is poured immediately to prevent any damage that may be caused by rain or prolonged exposure;
- **In-ground Electrical Works:** Once electrical trenches have been excavated it is important that cables are laid and trenches backfilled as soon as practicable so as to avoid damage to the trenches (and surrounding areas) due to exposure to the elements. Safety issues, for people, livestock and native animals, are reduced on early backfill of trenches; and
- **WTG Installation:** WTG Installation is intended to fit into the six-day working week. However, when erecting the tower, once the top of the tower is attached, the nacelle must go on without delay due to the risk of tower self-oscillation. Unfavourable weather can cause delays in mounting the nacelle. Continuing this work outside of standard construction hours will ensure that there is no risk to people, property and the surrounding environment from tower self-oscillation. The Project area is naturally a high wind area and as such Sunday work may be needed to make up for high wind days during the week.

The Proponent seeks approval to undertake construction activities outside the normal approved working hours without the approval of the Secretary, subject to the works meeting the following criteria:

- activities that are inaudible at non-associated residences;
- the delivery of materials requested by the NSW Police Force or other authorities for safety reasons;
- emergency work to avoid the loss of life, property and/or material harm to the environment; or

- in accordance with *Environmental Planning and Assessment (COVID-19 Development – Construction Work Days) Order 2020*.

4.6.3.2 Road Upgrades

With the exception of the OSOM vehicle transport route, the road upgrades will be undertaken prior to the commencement of construction to the satisfaction of the relevant roads authorities. The External Road Upgrades for the OSOM vehicle transport route from port of entry to the Project Site will be undertaken prior to OSOM vehicle transport (Table 4-4). Works will be undertaken by a suitably qualified contractor subject to the relevant authorisation. Site establishment and construction works may be undertaken in parallel with the road upgrades subject to preparation, approval and implementation of the TMP in consultation with the relevant road authorities.

4.6.3.3 Temporary Facilities

Construction of the Temporary Facilities will be undertaken during Pre-construction and Construction phases. Works will include the erection of temporary infrastructure such as a portable field office, toilet facilities and parking bays within the temporary construction compound, establishment of the rock crushing and batching plant facilities, stockpiles and materials storage as well as Temporary Field Laydown Areas. Arrangements will be made for power and communications at the site office during the construction period.

Temporary concrete or asphalt batching plant and rock crusher facilities will be established based on concrete pour optimisation to minimise vehicle movements, once the final Project layout is determined. Stockpiles, materials storage and laydown areas will be established to meet the needs of the final project layout to be constructed.

4.6.3.4 Ancillary Infrastructure

Internal Roads

Internal Roads, turning heads and hardstands will be established using heavy earthworks machinery (generally early in the construction program) to excavate the Internal Roads and hardstand areas to a depth determined under the relevant standards, prior to the laying of a compacted gravel. Material excavated on-site for WTG and compound foundations and internal road alignments will be crushed on-site and used for road base or aggregate subject to meeting the relevant functional specification.

Overhead Transmission Lines

Construction of the proposed overhead transmission lines requires the following works to be undertaken in accordance with an appropriate environmental management plan:

- site establishment including the provision of access;
- centreline surveying and service location;
- easement preparation, including the lopping and / or removal of trees;
- excavation and transmission pole erection; and
- conductor and earth wire installation (including pilot wire).

Equipment to be typically used during line construction includes:

- Semi-trailer for transportation of transmission poles, wires and other materials;
- 20 tonne crane;
- Pole borer;
- Wire spooler;
- Elevated work platform (EWP); and
- Concrete trucks.

Complex line construction methods including helicopter installation and blasting of transmission pole foundations may be required in areas of very complex terrain. However, the majority of the proposed overhead transmission line locations can be readily accessed during construction via cleared agricultural land, following negotiations with landholders. In some cases, track creation or enhancement may be required where access cannot be gained or is not considered adequate to support machinery utilised during the construction of the transmission line. A number of creek crossings may also be required to support the required machinery. Crossings not required for future maintenance activities will be decommissioned following the completion of construction works. Those that are required for ongoing use during operations will be designed and constructed in accordance with relevant guidelines.

Underground Transmission Lines

During WTG and Electrical Compound base construction, the underground transmission lines would be installed. This would involve the cutting or excavation of trenches for the laying of the underground transmission lines that link the Project components. The general procedure for the laying of underground transmission lines will be as follows:

- preparation work, including installation of gates / temporary removal of fences, as required;
- use of an excavator or rock saw to dig a trench;
- material excavated is stored adjacent to the trench for subsequent back-filling;
- laying of bundled cables within a bed of protective sand;
- placement of tape warning of the presence of electrical cables at the required depth; and
- backfilling and compaction of previously excavated material in layers by use of a vibration plate compactor, all in accordance with engineering specifications.

All trenches would be marked with warning tape and backfilled once the cables were in-situ. On completion the underground transmission lines may be marked with small marker posts and the surrounding vegetation will be allowed to regrow.

A number of creek crossings may also be required to support the required machinery. Crossings not required for future maintenance activities will be decommissioned following the completion of construction works. Those that are required for ongoing use during operations will be designed and constructed in accordance with relevant guidelines.

During construction, Temporary Field Laydown Areas will be positioned along the proposed transmission line route to store hard equipment such as transmission poles and conductors. No fuel, oil or chemicals will be stored at these locations. Minimal clearing will be required for the construction of overhead transmission lines.

Other Electrical Infrastructure

The ESF and Substations will either be constructed as separate compounds, or as combined compounds. Clearing and excavations will be undertaken, and reinforced concrete foundations will be constructed to support electrical infrastructure and buildings. Infrastructure required within the yard will include transformers, switchgear, power conditioning equipment, energy storage technology, switch room, cabling and backup generators. The Substations will be designed and constructed in line with TransGrid requirements and any other relevant technical, electrical and planning standards. On-site trafficked areas would be limited to areas at the site entrance and surrounding the switch room and control building. The Electrical Compound areas would be finished with coarse gravel and pebble material.

4.6.3.5 Wind Turbine Generators

Excavation of the WTG foundations will be undertaken to prepare the area for concrete pouring and WTG installation. Each foundation would be excavated, blinding layer of concrete placed, shuttering and steel reinforcement would be put in place and concrete poured to form the base in-situ. The upper surface of each base would finish approximately 0.5 m to 1 m below ground level with either a central reinforced concrete plinth to support the tower, or a base steel tower section set into the concrete.

If rock anchor foundations are required, the construction of the foundation for each WTG would involve less excavation. The rock anchor cores are drilled into the bedrock prior to concrete pour. The rock anchor tendons are grouted into place, stressed and secured once the concrete has cured sufficiently. Steel form shuttering and steel reinforcement would then be put in place and concrete poured to form the base in-situ. The upper surface of each base would finish at ground level with either a central reinforced concrete plinth to support the tower, or a base steel tower section set into the concrete.

The WTG components are delivered to the site progressively using OSOM truck and trailer combinations. Erection of WTGs is generally a two-stage process with the base and first two tower sections lifted into place. This generally takes one day to complete. Once this has been completed various minor works are undertaken before the remaining tower sections, nacelle, generator, hub and blades are lifted into place. This can take three days to complete depending on the prevailing weather conditions.

Both mobile cranes and tower crane methods are considered appropriate for this Project.

4.6.4 Commissioning

Pre-commissioning checks will be carried out on the high voltage electrical equipment prior to connection to the TransGrid transmission network. When the Project's electrical system has been energised, the WTGs and ESF will be commissioned and put into service. WTGs are commissioned sequentially enabling some WTGs to commence operation prior to the completion of wind farm construction. For the purposes of this EIS the commissioning phase is considered to commence during construction and will end once the final WTG and Electrical Compound has been fully commissioned.

4.6.5 Operations and Maintenance

Once operational, the Project would be monitored both by on-site staff and through remote monitoring. Aspects of the Project operation to be dealt with by on-site staff would include safety management (Figure 4-22), environmental condition monitoring, landowner management, routine servicing, malfunction rectification and site visits. Those functions to be overseen by remote monitoring include WTG and ESF performance assessment, Project reporting, remote resetting and maintenance co-ordination. Pro-active computer control systems monitor the performance of the WTGs and ESF ensure that any issues are dealt with by on-site staff or contractors, as appropriate.

Figure 4-22: Example of safety management for on-site staff

Maintenance staff will be on-site throughout the year, making routine checks of the WTGs, ESF and Ancillary Infrastructure on an ongoing basis. Major planned servicing would be carried out approximately twice a year on each WTG. Each major service visit would potentially involve a number of service vehicle (two technicians per vehicle) on-site. Maintenance staff will work within the O&M Compound and throughout the Project Site during normal operation.

On-site maintenance will require permanent access to the WTGs and ESF to address technical and mechanical servicing requirements. Replacement of major components, such as WTG blades, may require the use of cranes and ancillary equipment. This can result in a WTG being offline for several weeks whilst the appropriate equipment and materials are sourced.

Management of regrowth and existing vegetation will be necessary within the overhead transmission line corridors to reduce the threat of fire and physical damage to the transmission line, and to allow access for maintenance vehicles. This will be carried out using mechanical, manual and chemical clearing methods prior to construction activities commencing and as part of ongoing maintenance activities for the duration of the Project.

Following construction of the overhead transmission line, maintenance will most likely be limited to yearly inspections in a 4WD vehicle to check the integrity of the transmission poles and other associated infrastructure. Occasionally, access by medium and heavy vehicles may be required to repair or maintain overhead transmission line components. Access will be gained via dedicated on-site Internal Roads within the overhead transmission line corridor.

Asset management is intended to be carried out by CWPR Asset Management, unless commercial or other arrangements change. All Project and construction management will comply with the appropriate company's Quality Assurance System and EMS, or equivalent, ensuring that relevant procedures, statutory requirements and operational standards are met. The Substations and other elements of the connection infrastructure will be operated by TransGrid, and therefore separate operational EMPs will be prepared.

4.6.6 Repowering

After approximately 30 years of operation (or sooner if deemed economically viable) the Project may be repowered, utilising contemporary equipment. Repowering would extend the life of the Project for a further 30 years. Some or all of the Project equipment may be repowered depending on the economics at the time. Repowering would require the equivalent transportation and installation equipment and facilities used during the initial construction. Further details relating to repowering are outlined in Section 8.

4.6.7 Decommissioning

At the end of the operational life of the Project, all above ground infrastructure will be dismantled and removed from the Project Site. This may not include the connection infrastructure which may be essential to be retained. WTG tower bases would be cut back to below ploughing level or topsoil built up over the foundation to achieve a similar result. The land will be returned to near prior condition and use. A compressor and rock crusher may be needed to carry out the cutting work.

Internal Roads, if not required for ongoing farming purposes or fire access, would be removed and the Project Site reinstated as close as possible to its original condition and use. Access gates, if not required for farming purposes, would also be removed. Individual landowners will be involved in any discussion regarding the removal or hand-over of infrastructure on their property.

The underground transmission lines are buried below ploughing depth and contain no harmful substances. Further, removing them would involve further unnecessary vegetation disturbance.

Accordingly, they would be left in the ground and only recovered if economically and environmentally viable. Terminal connections would be cut back to below ploughing levels.

All decommissioning work would be the responsibility of the Project owner and provision for this has been included in the lease arrangements agreed with the landowners. Further details relating to decommissioning are outlined in Section 8.

5 Statutory Framework

In meeting contemporary community expectations in regard to environmental and social impacts, the Project must respond to prevailing statutory requirements at a Commonwealth, State and Local Government level. In doing so, the Project demonstrates its validity and conformance with underlying social principles and expectations.

This section addresses compliance requirements under Federal, State and local legislation relevant to the Project including NSW State Environmental Planning Policies (SEPPs), Regional and Local Environmental Plans (REPs & LEPs). Any additional approvals, licenses or permits which are required are also identified. SEARs requirements include:

- a list of any approvals that must be obtained before the development may commence;
- the terms of any proposed voluntary planning agreement with the relevant local council
- an assessment of the likely impacts of the development on the environment, focusing on the specific issues identified below, including:
  - *an assessment of the likely impacts of all stages of the development, taking into consideration any relevant legislation, environmental planning instruments, guidelines, policies, plans, industry codes of practice and including the NSW Wind Energy Guideline for State Significant Wind Energy Development (2016);*
- the reasons why the development should be approved having regard to:
  - *relevant matters for consideration under the Environmental Planning and Assessment Act 1979, including the objects of the Act, evaluation of the merits of the project as a whole and how the principles of ecologically sustainable development have been incorporated in the design, construction and ongoing operations of the development;*
  - *the environmental, economic and social costs and benefits of the development, having regard to the predicted electricity demand in NSW and the National Electricity Market, the Commonwealth's Renewable Energy Target Scheme, and the greenhouse gas savings of the development;*
  - *a detailed consideration of the capability of the project to the security and reliability of the electricity system in the National Electricity Market, having regard to local system conditions and the Department's guidance on the matter.*

5.1 Permissibility

The Project Site is located within the Dubbo Regional Council LGA; however, the land on which the WTGs and Ancillary Infrastructure are proposed is within the former Wellington Council LGA to which the *Wellington LEP 2012* currently applies. The Site is entirely situated on land zoned as RU1 Primary Production under the Wellington LEP (Figure 5-1).

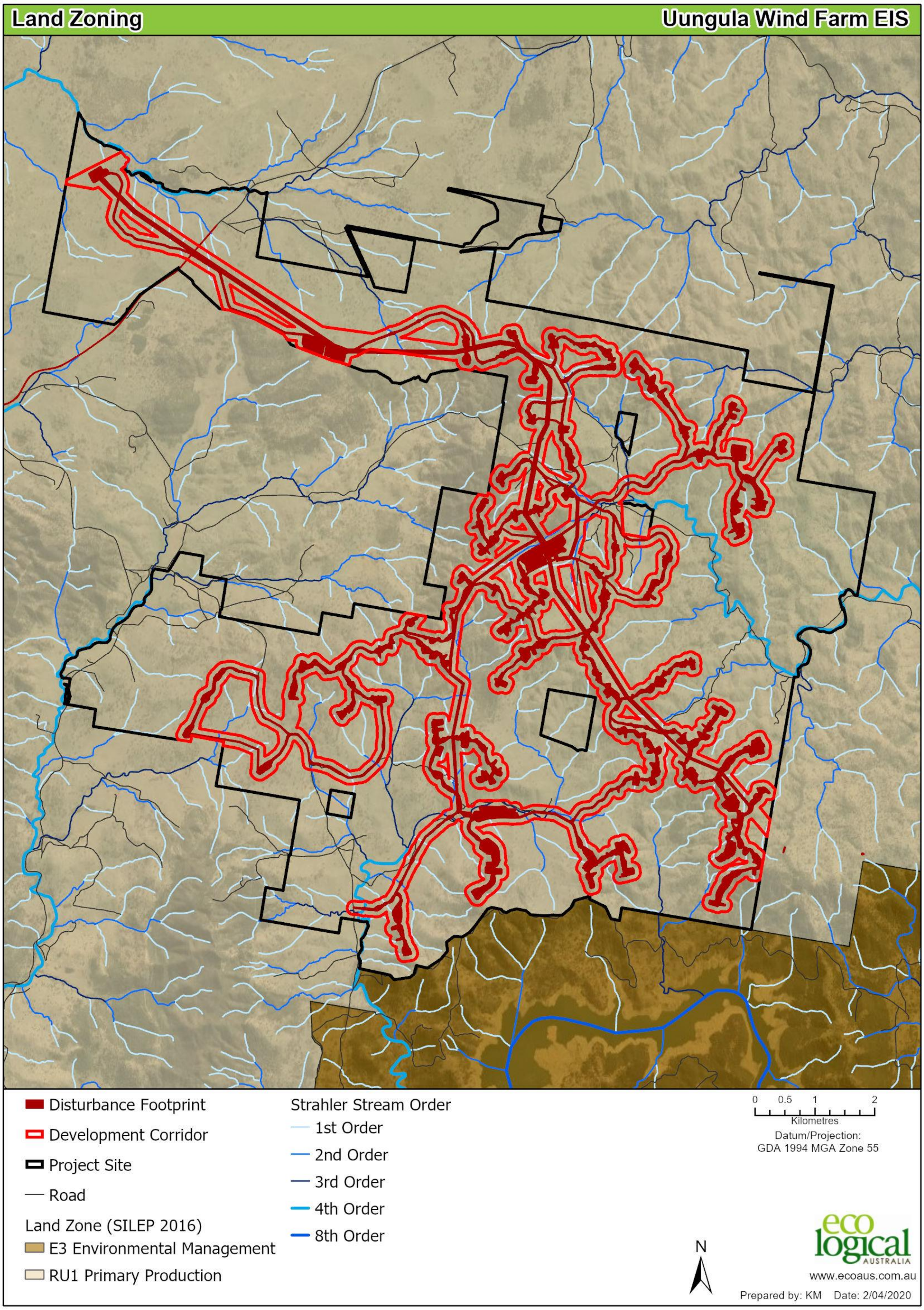


Figure 5-1: Land use zones within the Project Site

Wind energy systems are prohibited in the RU1 Zone; however, pursuant to clause 34(1b) of the *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP), development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial or special use zone. Given that the Project is located on prescribed rural land, and the proposed activity is to generate electricity from wind, the Project is defined as electricity generating works (wind energy systems) and is permissible with consent under clause 34(1b) of the ISEPP. Development consent for the Project is sought under Part 4 EP&A Act.

Under Schedule 1 (clause 20) of the SEPP(SRD), electricity generating works with a capital investment value of more than $30 million are classed as SSD and therefore the consent authority is DPIE. The Project has a capital investment value estimated to be greater than $30 million, and therefore is deemed SSD. As the activity is SSD, the assessment framework for the Project is Division 4.7 of the EP&A Act.

5.2 Commonwealth Legislation

5.2.1 Environment Protection & Biodiversity Conservation Act 1999 (EPBC Act)

The EPBC Act is the central piece of environmental legislation for the Australian government. It provides the legal framework to protect and manage MNES, while also considering cultural values and society's economic and social needs. The EPBC Act protects MNES, such as threatened species and ecological communities, migratory species (protected under international agreements), and national heritage places (among others).

Any actions that will, or are likely to, have a significant impact on MNES require referral to, and approval from, the Australian Government Environment Minister. Significant impacts are defined by the Commonwealth guidelines and policies for MNES (Department of the Environment, 2013; Department of Agriculture, Water and the Environment, 2020).

Some MNES have been identified as potentially occurring on or near the Site, including Threatened Ecological Communities (TECs) and threatened species. Potential MNES impacts are summarised in Table 5-1. The Project was originally referred to the Australia Government Environment Minister in 2013 and was deemed a Controlled Action. Confirmation was sought to determine if the Proposed Action could be assessed under the Bilateral Agreement. Confirmation was received in 2017 (Appendix B).

Table 5-1: Impacts on Matters of National Environmental Significance

Factor		Likely impact
a.	*Any impact on a World Heritage property?* The Project would not impact any World Heritage property	Nil
b.	*Any impact on a National Heritage place?* The Project would not impact any National Heritage place	Nil
c.	*Any impact on a wetland of international importance?* The Project would not impact any wetland of international importance	Nil
d.	*Any impact on a listed threatened species or communities?* Detailed habitat assessments and targeted flora and fauna surveys addressed in Section 8.4 of this EIS and Appendix G and Appendix H, indicate that the Project is likely to impact on EPBC listed threatened species or TECs.	Likely. Impacts to significantly impacted MNES will be offset in accordance with the BBCC.
e.	*Any impacts on listed migratory species?* Assessments in Section 8.4 of this EIS and Appendix G and Appendix H, indicate that the Project is unlikely to impact on any Commonwealth-listed migratory species	Unlikely
f.	*Any impact on a Commonwealth marine area?* The Project would not impact any Commonwealth marine area	Nil
g.	*Does the proposal involve a nuclear action (including uranium mining)?* The Project does not involve a nuclear action	Nil
h.	*Additionally, any impact (direct or indirect) on Commonwealth land?* No Commonwealth land would be impacted by the Project	Nil

5.2.2 Native Title Act 1993

The *Native Title Act 1993* recognises the rights and interests of Indigenous people to land and aims to provide for the recognition and protection of common law native title rights. Areas of land within the Project Site where native title may exist include public road reserves and other Crown land.

A search of the National Native Title Tribunal Register was undertaken in February 2020. There were no native title applications, determinations of native title, or Indigenous Land Use Agreements existing over the Site. As such, the Project Site is not subject to any native title claims at this time.

5.2.3 Renewable Energy (Electricity) Act 2000 (RE Act)

The RE Act aims:

a) to encourage the additional generation of electricity from renewable sources;

b) to reduce emissions of greenhouse gases in the electricity sector; and

c) *to ensure that renewable energy sources are ecologically sustainable.*

The objects of the RE Act are achieved through the issuing of certificates for the generation of electricity using eligible renewable energy sources. This requires certain purchasers of electricity (called liable entities) to surrender a specified number of certificates for the electricity that they acquire during a year.

Under section 17 of the RE Act, wind energy is a renewable energy source eligible under the Commonwealth Government's Renewable Energy Target (RET). The Project will need to be accredited as a Renewable Energy Generator to create Renewable Energy Certificates (large scale).

Section 3.3 discusses how the Project is consistent with the aims of the RE Act and will help meet the targets of the RET by producing renewable energy for Australia's electricity grid.

5.2.4 Hazardous Waste (Regulation of Exports and Imports) Act 1989 (Hazardous Waste Act)

The Hazardous Waste Act regulates the export, import and transit of hazardous waste to ensure human beings and the environment, both within and outside of Australia are protected from the harmful effects of hazardous wastes. Pursuant to section 40 of the Hazardous Waste Act, "*A person must not export hazardous waste unless:*

a) the person is the holder of an export permit authorising the person to export the waste; or

b) the person is the holder of a transit permit authorising the person to export the waste; or

c) *the export has been ordered under section 34 or 35A."*

Lithium ion batteries may be selected as the battery technology for the Project. Spent lithium ion batteries would constitute a hazardous waste. Presently, there are few facilities to recycle lithium-ion batteries in Australia. Therefore, spent batteries would likely be exported and would require an export permit under section 40 of the Hazardous Waste Act. The Proponent would coordinate this activity and the associated commercial arrangements with the selected battery supplier. There would be no other hazardous wastes produced by the Project.

5.2.5 National Airports Safeguarding Framework 2012

To address the risk to civil aviation arising from the development, presence and use of wind farms and wind monitoring towers, the National Airports Safeguarding Advisory Group (NASAG) in May 2012 released *Guideline D: Managing the Risk of Wind Turbine Farms as Physical Obstacles to Air Navigation* as part of their The National Airports Safeguarding Framework.

The guideline encourages consultation with aviation stakeholders and the preparation of a risk assessment using a suitably qualified aviation consultant. Accordingly, CASA, Airservices Australia (AsA), Aerial Agricultural Association of Australia (AAAA), Department of Defence (DoD) and the Royal Australian Air Force (RAAF) have been consulted as discussed in Section 6. The recommendations from CASA and results of the risk assessment are discussed in Section 8.6.2.

5.2.6 *Civil Aviation Safety Regulations 1998* (CASR)

Part 139, Subpart 139E "Obstacles and Hazards" of the CASR require that CASA be informed of proposals to build a structure greater than 110 m above ground level. This is to determine whether the structure is a potential hazard to aircraft, and to provide any associated mitigation measures including marking or lighting. Information and data, including the preliminary height and location of the proposed WTGs, ESF and Ancillary Infrastructure has been provided to CASA, who has reviewed the information provided to determine whether any of the structures represent a potential obstacle or hazard due to their height, location or lack of marking/lighting (see Section 8.6.2). On receipt of Development Approval for the Project, and regarding the Aviation Impact Statement, the Proponent will consult with CASA and the Department of Infrastructure, Transport, Regional Development and Communications (DITRDC) on the issue of obstacle lighting. Aviation impacts are considered in more detail in Section 8.6.

5.2.7 *Radiocommunications Act 1992* (Radiocommunications Act)

The Radiocommunications Act is the primary legislation for regulation of telecommunications services within Australia. Part 4.1 'Standards and other technical regulation' of the Radiocommunications Act is designed to make the introduction of infrastructure such as WTGs efficient, flexible and responsive regarding the interference of radio emissions. The standards also require an adequate level of immunity from electromagnetic interference. As WTGs and associated ancillary structures produce electromagnetic fields, the Project has the potential to interfere with radiocommunications. Detailed design and positioning of all WTG sites have been made to ensure adequate setbacks from microwave link paths passing through the wind farm site. The wind farm is sited to ensure no interference with television reception at residences surrounding the wind farm. Nevertheless, various measures are available to mitigate any impacts on television services should they occur, depending on the nature of the interference and circumstances of the receiver. Telecommunications interference is considered in more detail in Section 8.6.3.

5.3 State Legislation

5.3.1 *Environmental Planning and Assessment Act 1979* (EP&A Act)

The EP&A Act is the principal planning legislation for NSW. It provides a framework for the overall environmental planning and assessment of development proposals. As the activity is SSD, the assessment framework for the Project is Division 4.7 of the EP&A Act.

The Site will be leased for the purposes of the Project. Since the lease will extend for a term greater than five years, the Project will be deemed 'subdivision' of land pursuant to Section 1.5(1)(b) of the EP&A Act. The proposed lots to be created as part of the subdivision for leasing purposes and indicative lot sizes are detailed in Section 4.1.2. It is noted that this is not an actual subdivision of the land which creates a new allotment and deposited plan, and that the current DPIE approach is that a formal request for a subdivision certificate compliant with the requirements of clause 157 of the EP&A Regulation is not required. Development consent is sought for these subdivisions inclusive of minor lot boundary variations should adjustment be required at the detailed design stage.

Under the provisions of section 4.15 of the EP&A Act, the consent authority is required to consider several matters pertaining to the relevant Plans and Policies that apply to any development application for SSD. These matters are identified and assessed through the preparation of this EIS.

The EP&A Act identifies four key principles to assist in the achievement of ESD, which are described in detail in Section 3.5.

5.3.2 *State Environmental Planning Policy (State and Regional Development) 2011* (SEPP(SRD))

Clause 20 of Schedule 1 of the SEPP(SRD) states that "*development for the purpose of electricity generating works or heat or their co-generation (using any energy source, including gas, coal, biofuel, distillate, waste, hydro, wave, solar or wind power) that have a capital investment value of more than $30 million*" shall be classified as SSD under Division 4.7 of the EP&A Act.

The Project has a capital investment value estimated to be greater than $30 million, and therefore is deemed SSD. A signed report from a suitably qualified person confirming the capital investment value of the Project is to be provided to DPIE separately to this EIS as part of the DA.

The Minister for Planning and Public Spaces is the consent authority for SSD applications. SSD applications are assessed by DPIE, and in some cases the Minister may delegate decision making to Department staff. However, the IPC is the consent authority for SSD applications where specific conditions occur.

5.3.3 *State Environmental Planning Policy (Infrastructure) 2007* (ISEPP)

The ISEPP was introduced to facilitate the effective delivery of infrastructure across NSW. In most cases, the ISEPP overrides the provisions of other Environmental Planning Instruments and provides permissibility and development assessment provisions which apply across the State for different infrastructure sectors.

Division 4 of the ISEPP applies to the Project as it is ‘electricity generating works’ which is defined as a building or place used for the purpose of making or generating electricity. However, pursuant to clause 34(1b) of the ISEPP, development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial or special use zone. Given that the Project is located on prescribed rural land, and the proposed activity is to generate electricity from wind, the Project is permissible with consent.

5.3.4 *State Environmental Planning Policy (Primary Production and Rural Development) 2019* (Primary Production and Rural Development SEPP)

The aims of the Primary Production and Rural Development SEPP are as follows:

(a) to facilitate the orderly economic use and development of lands for primary production,

(b) to reduce land use conflict and sterilisation of rural land by balancing primary production, residential development and the protection of native vegetation, biodiversity and water resources,

(c) to identify State significant agricultural land for the purpose of ensuring the ongoing viability of agriculture on that land, having regard to social, economic and environmental considerations,

(d) to simplify the regulatory process for smaller-scale low risk artificial waterbodies, and routine maintenance of artificial water supply or drainage, in irrigation areas and districts, and for routine and emergency work in irrigation areas and districts,

(e) to encourage sustainable agriculture, including sustainable aquaculture,

(f) to require consideration of the effects of all proposed development in the State on oyster aquaculture,

(g) to identify aquaculture that is to be treated as designated development using a well-defined and concise development assessment regime based on environment risks associated with site and operational factors.

The relevant aims of this policy relate to measures designed to reduce land use conflicts. Clause 10 outlines the Objects of Part, being:

- to provide for the protection of agricultural land –
  - that is of State or regional agricultural significance, and
  - that may be subject to demand for uses that are not compatible with agriculture, and
  - if the protection will result in a public benefit.

Pursuant to clause 11, Part 2, land identified as being State significant agricultural land is listed in schedule 1 of the Primary Production and Rural Development SEPP. Currently, schedule 1 does not list any State significant agricultural land. Therefore, the Project will not impact upon agricultural land that is of State or regional agricultural significance.

Section 8.9 discusses land use conflicts between the Project and the agricultural activities currently undertaken onsite. Ultimately, the Project Site will continue to be used for the purposes of agriculture once the Project has been constructed, and development for the purposes of electricity generating work, namely wind farms, does not compromise any of the above objectives or impact any State significant agricultural land.

5.3.5 *State Environmental Planning Policy No. 44 (Koala Habitat)* (SEPP 44)

SEPP 44 aims to encourage the proper conservation and management of areas of natural vegetation that provide habitat for *Phascolarctos cinereus* (Koala) to ensure a permanent free-living population over their present range and reverse the current trend of Koala population decline. Developers of land with Koala habitat must consider the impact of their proposal on Koalas, and in certain circumstances, prepare individual Koala plans of management for their land.

Dubbo Regional Council LGA (as well as both the former Dubbo Shire and Wellington Councils) is not listed as one of the Councils in which SEPP 44 applies.

Impacts to the Koala were assessed in accordance with the FBA (Section 8.4), where Koala habitat was defined by species polygons over associated vegetation communities. To mitigate potential impacts to Koala habitat, the Proponent is intending on retiring species credits for this species.

5.3.6 *State Environmental Planning Policy No. 33 – Hazardous & Offensive Development* (SEPP 33)

SEPP 33 defines and regulates the assessment and approval of potentially hazardous or offensive development. Under clause 3 of the SEPP 33, a 'potentially hazardous industry' is defined as,

"… *a development for the purposes of any industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would pose a significant risk in relation to the locality:*

a) to human health, life or property, or
b) to the biophysical environment,

and includes a hazardous industry and a hazardous storage establishment."

Clause 3 also defines a 'potentially offensive industry' as,

"… a development for the purposes of an industry which, if the development were to operate without employing any measures (including, for example, isolation from existing or likely future development on other land) to reduce or minimise its impact in the locality or on the existing or likely future development on other land, would emit a polluting discharge (including for example, noise) in a manner which would have a significant adverse impact in the locality or on the existing or likely future development on other land, and includes an offensive industry and an offensive storage establishment."

A Preliminary Hazard Analysis (PHA) is required for development proposals classified as 'potentially hazardous industry' to determine the risks to people, property and the environment. Appendix 3 of the *Applying SEPP 33* guidelines (NSW DPE, 2011) list the industries that are considered to fall within SEPP 33. Wind farms and energy storage facilities are not listed in Appendix 3, however an assessment of hazardous activities associated with the Project is provided in Section 8.6 and Appendix F.

5.3.7 *State Environmental Planning Policy No. 55 – Remediation of Land* (SEPP 55)

SEPP 55 aims to promote remediation of contaminated land for the purpose of reducing the risk of harm to human health or any other aspect of the environment.

Under clause 7, a consent authority must not consent to the carrying out of any development on land unless:

a) it has considered whether the land is contaminated, and
b) if the land is contaminated, it is satisfied that the land is suitable in its contaminated state (or will be suitable, after remediation) for the purpose for which the development is proposed to be carried out, and
c) if the land requires remediation to be made suitable for the purpose for which the development is proposed to be carried out, it is satisfied that the land will be remediated before the land is used for that purpose.

A review of the EPA Contaminated Land Record under section 58 of the *Contaminated Land Management Act 1997* (CLM Act) and the List of NSW contaminated sites notified to the NSW EPA under section 60 of CLM Act did not reveal any registered contaminated land sites within or surrounding the Site/WTG sites (EPA, 2020).

A review of premises currently regulated by an EPL under the POEO Act and premises that are no longer required to be licensed under the POEO Act did not identify any EPLs within or surrounding the Project Site.

There is a risk of contamination from agricultural activities such as pesticides that may be present within the Project Site. However, the risk is considered low and no evidence of contamination was observed during the site assessments. Pursuant to clause 7 of SEPP 55 there is no apparent reason to consider that land to be impacted by the Project would be contaminated and no further studies or detailed assessments are warranted.

5.3.8 *Biodiversity Conservation Act 2016* (BC Act)

The purpose of the BC Act is to maintain a healthy, productive and resilient environment for the greatest well-being of the community, now and into the future, consistent with the principles of ecologically sustainable development. The BC Act contains provisions relating to; threatened species and ecological community listings and assessment; section 1.7 of the EP&A Act; and repealing the *Threatened Species Conservation Act 1995* (TSC Act). The BC Act provides for a BOS incorporating a single BAM, calculation and retirement of biodiversity credits and biodiversity assessment and approvals. The BC Act also contains measures for flora and fauna protection, repealing parts of the *National Parks and Wildlife Act 1974* (NPW Act).

The BC Act commenced on 25 August 2017. Under clause 28 of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017* (BC Savings and Transitional Regulation) the former assessment and planning framework applies to pending SSD development applications if the SEARs were issued prior to the commencement of the BC Act and the application is made within 18 months after the commencement of the BC Act. Where SEARs are re-issued, then the modification application must be made within 18 months after the re-issue of the SEARs (but no later than 3 years after the commencement of the BC Act, which will be Tuesday, 25 August 2020).

SEARs for the Project were first issued on 20 December 2016 and then re-issued on 11 November 2019 (retaining reference to the FBA given the DPIE and OEH opinion that the assessment work had 'substantially commenced'), hence the Project is being assessed under the former provisions of the TSC Act (see below).

5.3.9 *Threatened Species Conservation Act 1995* (TSC Act)

The TSC Act lists and protects threatened species, populations and ecological communities that are under threat of extinction in NSW. NSW DPIE is responsible for administering the TSC Act.

The TSC Act establishes a system for biodiversity certification and establishes the Biodiversity Banking and Offsets Scheme. All major projects require that impacts to biodiversity under the TSC Act are assessed in accordance with the FBA. Potential impacts of the Project to biodiversity are assessed and described in detail in Section 8.4 and Appendix G.

5.3.10 *Fisheries Management Act 1994* (FM Act)

The FM Act provides for the protection, conservation, and recovery of threatened aquatic species defined under the Act. It also makes provision for the management of threats to threatened aquatic species, populations, and ecological communities defined under the Act, as well as the protection of fish and fish habitat in general.

There are several waterbodies including Uungula Creek, Ilgingery Creek, Wuuluman Creek, and its tributary Bulls Gully, which are mapped as Key Fish Habitat (KFH) within the Project Site, and further KFH is identified downstream of the Site (NSW DPI, n.d.). The Wuuluman Creek catchment is also mapped as part of the Darling Endangered Ecological Community (NSW DPI, n.d.). KFH is not defined under the FM Act, however the NSW Department of Primary Industries (DPI) provides a definition for KFH as generally including habitats that are crucial to the survival of native fish stock, excluding man-made habitats such as off-stream dams and ponds, and those natural waterways which are dry for the majority of the time or have limited habitat value. Given the ephemeral and highly modified nature of the creeks within the Project Site, they are potential poor quality KFH, however, this requires ground truthing to confirm.

In accordance with Part 4, Division 1.7, section 4.41 (b) of the EP&A Act, applications for separate permits under sections 201, 205 or 219 of the FM Act are not required for SSD, but the offset policy still applies under the FM Act. In order to inform a comparative and acceptable assessment of impacts to threatened species and/or aquatic habitat, the regulatory framework of the FM Act and associated guidelines have been adopted for this assessment. Potential impacts to threatened aquatic fauna and ecological communities listed under Schedule 4 of the FM Act are assessed in Section 8.9.

5.3.11 *Water Management Act 2000* (WM Act)

The main objective of the WM Act is to manage water in NSW in a sustainable and integrated manner that will benefit current generations without compromising future generations' ability to meet their needs. The WM Act is partly administered by WaterNSW and establishes an approval regime for activities within waterfront land, defined as the bed of any river, lake or estuary, together with any land within 40 m from the highest bank of a river, lake or estuary.

Under the WM Act framework, activities and works proposed on waterfront land are regulated as controlled activities (NSW DPIE-Water, 2020). These controlled activities are defined as:

- The construction of buildings or carrying out of works;
- The removal of material or vegetation from land by excavation or any other means;
- The deposition of material on land by landfill or otherwise; and
- Any activity that affects the quantity or flow of water in a water source.

The installation of cables, construction of Internal Roads over waterways, associated culverts and other drainage works are controlled activities that will likely be undertaken partially on waterfront land for the Project.

In accordance with Part 4, Division 1.7, section 4.41(g) of the EP&A Act, a water use approval under section 89, a water management work approval under section 90, or an activity approval (other than an aquifer interference approval) under section 91 of the WM Act are not required to be separately sought for SSD where the SSD development consent authorises those uses or activities.

Accordingly, this development application seeks authorisation for those works that would otherwise require a controlled activity approval under section 91 of the WM Act.

The WM Act and Regulations provide that construction of fencing, crossings or tracks is exempt from the requirement for approval if the activity:

(a) Does not impound water, and is (b) Located on a minor stream (as per the *Water Management (General) Regulation, 2019* (NSW)), and is (c) Located within a rural zone (section 42 and, Part 2 of Schedule 4 (item 23) of the *Water Management (General) Regulation 2019)*.

In order to inform a comparative and acceptable assessment of riparian impacts, the regulatory framework of the WM Act and associated guidelines have been adopted for this assessment.

Natural Resources Access Regulator's (NRAR's) *Guidelines for Controlled Activities on waterfront land—Riparian corridors* (NRAR, 2018) outlines the need for a Vegetated Riparian Zone (VRZ) adjacent to the channel to provide a transition zone between the terrestrial environment and watercourse. This vegetated zone helps maintain and improve the ecological functions of a watercourse whilst providing habitat for terrestrial flora and fauna. The VRZ plus the channel (bed and banks of the watercourse to the highest bank) constitute the 'riparian corridor'. NRAR recommends a VRZ width based on watercourse order as classified under the Strahler System (1952) of ordering watercourses and using Hydroline Spatial Data which is published on the department's website. The recommended VRZ has been adopted within the Project layout design, where feasible. A detailed discussion of these matters is contained in Section 8.9.

Water licensing is also controlled under the WM Act. Water licences for the Project will be obtained in accordance with the WM Act.

5.3.12 *Local Land Services Act 2013* (LLS Act)

The LLS Act provides the framework for clearing of native vegetation that does not require development consent on rural land in NSW. It is an offence under section 60N of the LLS Act for a person to clear native vegetation in a regulated rural area, unless the person establishes any of the following defences:

a) that the clearing is for an allowable activity authorised under Division 4 and Schedule 5A,
b) that the clearing is authorised by a land management (native vegetation) code under Division 5,
c) that the clearing is authorised by an approval of the Panel under Division 6,
d) *that the clearing is authorised under section 60O (Clearing authorised under other legislation etc.).*

This Development Application, including vegetation clearing, is being assessed under Part 4 of the EP&A Act, hence clearing of vegetation for the purpose of the Project as authorised under this Act does not require approval under Division 6 of Part 5A of the LLS Act.

Although for the reasons described above, the Project does not require approval under Division 6 of Part 5A of the LLS Act, the definition of 'clearing' is adopted from the LLS Act in the absence of any other practical legislated definition of clearing.

5.3.13 National Parks and Wildlife Act 1974 (NPW Act)

The main aim of the NPW Act is to conserve the natural and cultural heritage of NSW. The NPW Act governs the establishment, preservation and management of national parks, historic sites and conservation areas. The Act also provides the basis for the legal protection and management of threatened native flora and fauna and Aboriginal sites within NSW.

To ensure accordance with the relevant parts of the NPW Act, the Proponent has conducted an assessment of flora and fauna in Appendix G with an overview provided in Section 8.4.

To ensure accordance with the Act, a process of Aboriginal community consultation has been undertaken in accordance with OEH's *Aboriginal Cultural Heritage Consultation Requirements for Proponents*. An Aboriginal Cultural Heritage Assessment (ACHA) was prepared for the Project Site which identified and assessed Aboriginal heritage values and potential impacts across the Project Site (Section 8.7 and Appendix J). This was further corroborated through additional surveys and the preparation of an ACHA addendum report by Austral Archaeology (Section 8.7 and Appendix K). Field surveys were attended by representatives from the Wellington Valley Wiradjuri Aboriginal Corporation, Gallangabang Aboriginal Corporation, Murong Gialinga and Mudgee Local Aboriginal Land Council (LALC).

Potential impacts will be managed through the development of a CHMP. Test excavations may be warranted at certain locations, should direct impacts remain following detailed design and micro-siting. Pursuant to section 4.41 of the EP&A Act, an Aboriginal Heritage Impact Permit (AHIP) under section 90 of the NPW Act is not required for SSD.

5.3.14 Heritage Act 1977 (Heritage Act)

Historic relics, buildings, structures and features are protected under the Heritage Act. The Heritage Act defines 'environmental heritage' as those places, buildings, works, relics, moveable objects and precincts of Local or State significance. Identified heritage items are listed in the heritage schedule of the local Council's LEP or listed on the State Heritage Register, or by an active Interim Heritage Order.

Under section 139 of the Heritage Act, a person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damage or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit. A relic is any deposit, artefact, object or material that relates to the settlement of the area that comprises NSW, not being Aboriginal settlement, and is of State or local heritage significance. Section 139 does not apply to a relic that is subject to an interim heritage order made by the Minister or a listing on the State Heritage Order.

The potential impacts on historic heritage are addressed in Section 8.7. No direct or indirect impacts are anticipated to registered heritage items or places. Mitigation strategies are identified for previously unassessed and unexpected heritage finds located within the Development Corridor. Pursuant to section 4.41 of the EP&A Act, a section 139 permit is not required.

5.3.15 Crown Land Management Act 2016

The *Crown Land Management Act 2016* and the *Crown Land Legislation Amendment Act 2017* came into effect on 1 July 2018, repealing and consolidating seven pieces of legislation, including the *Crown Lands Act 1989*. Crown land includes Crown reserves, state parks, land that is leased or licensed, minor ports, river entrances, caravan parks, places of cultural and community significance, submerged land of public waterways (except where under the ownership of NSW Maritime Authority) and Crown roads. It is an offence to reside, erect a structure, graze or drove livestock, clear, dig up, cultivate or enclose public land without lawful authority. Under Part 3 "Management of Crown Land" of the Act, the land must be assessed to consider capacities and suitable uses prior to any allocation action of Crown land including lease, sale, reservation, dedication, licence or permit.

Crown roads are generally unformed ('paper roads') that provide lawful access to freehold or leasehold land where little or no subdivision has occurred since the original Crown subdivision of NSW in the early 19th century. The Minister is the authority for all Crown roads.

The Project Site includes Crown land and paper roads. The proponent has applied to the NSW Department of Industry – Lands & Water's crown land department for licences over the crown lands and roads within the Development Corridor under Part 5 of the *Crown Land Management Act 2016.*

5.3.16 Conveyancing Act 1919 (Conveyancing Act)

Under section 23F of the Conveyancing Act, the Registrar-General can refuse to register a transaction in relation to the lease of part of an existing lot unless the boundaries of each part into which the land is divided follows the boundaries of an existing lot. There is an exception for a lease where the term does not exceed 5 years.

As such, because each lease required to secure the land for the Project will exceed five years, the Registrar-General will not register the leases unless development consent is obtained for the subdivision of the land for leasing purposes. An indicative subdivision plan is described in Section 4.1.2 of this EIS.

The Wellington LEP provides that land may be subdivided with development consent (clause 2.6) but any resulting lot must not be less than the identified minimum lot size (clause 4.1(3)). The applicable minimum lot size for the Project site is 100 ha (RU1 Primary Production zone). Therefore, the creation of a lot for lease purposes which is less than 100 ha is prohibited under the Wellington LEP. This prohibition applies to all Proposed Lots. Despite this prohibition, section 4.38(3) of the EP&A Act allows the consent authority to grant development consent to SSD which is partly prohibited. Accordingly, development consent may be granted, inclusive of this subdivision. It is the intention of this EIS (specifically described in Section 4.1.2) to form the application for 'deemed subdivision'.

Section 88B of the Conveyancing Act also provides for the creation of easements which benefit the land and its intended uses. Once the land is subdivided and the deposited plans registered, easements for access tracks, right of carriageway, transmission lines and power cabling may need to be sought and registered with NSW Land Registry Services where these land carriageway rights are required.

5.3.17 Roads Act 1993 (Roads Act)

Section 138 of the Roads Act sets out the requirement for approval to carry out certain works within the vicinity of a road. Under section 138 a person must not, without consent of the appropriate roads authority:

- *a) Erect a structure or carry out a work in, on or over a public road;*
- *b) Dig up or disturb the surface of a public road;*
- *c) Remove or interfere with a structure, work or tree on a public road;*
- *d) Pump water into a public road from any land adjoining the road; and/or*
- *e) Connect a road (whether public or private) to a classified road.*

The Project will be accessed via a series of state, regional and local roads, with immediate access to the Site via Twelve Mile Road. These are existing public roads that are currently operational and do not require new construction, rather upgrades. Approval to connect to a public road and to undertake work in, on or over a public road is required under section 138 of the Roads Act, which is an application for provisions of private access through Dubbo Regional Council. Transport routes and traffic analysis for the Project are assessed in Section 8.5, Appendix L, Appendix M and Appendix N, including a schedule of recommended road upgrades.

Formal applications for road upgrades under section 138 of the Roads Act will be undertaken during the post-approval agency liaison process.

5.3.18 Protection of the Environment Operations Act 1997 (POEO Act)

The objectives of the POEO Act are to protect, restore and enhance the quality of the environment, in recognition of the need to maintain ecologically sustainable development. The Act is administered by DPIE, the EPA, local councils and other public authorities. The EPA issues EPLs to control the air, noise, water and waste impacts of a scheduled activity.

Pursuant to section 48 of the POEO Act, scheduled activities (premises-based), as defined in Schedule 1, require EPLs from the NSW EPA. Under clause 17 of Schedule 1, electricity works (wind farms) are a scheduled activity and an EPL is required for wind energy projects which are deemed SSD. Therefore, the Project is a scheduled activity under the POEO Act, and an EPL is required.

The NSW EPA provides advice to DPIE when the application is being assessed. The requirements of an EPL regulate the construction and operational phases of large-scale wind energy projects under the POEO Act, including noise pollution. Schedule 1 of the *Protection of the Environment Operations (General) Regulation 2009* (POEO Regulation) sets out applicable license administration for large-scale wind farms.

The Project will require an EPL to operate, with the noise limits prescribed in the licence conditions, being substantially consistent with the planning consent. In addition, during the construction phase a licence may be necessary for crushing, grinding or separating if the activity has the capacity to process more than 150 tonnes of materials per day or 30,000 tonnes of materials per year.

Part 5.7 of the POEO Act provides the duty to notify the relevant authority of pollution incidents, and under section 120 it is an offence to pollute waters. The Proposed Development will be managed to ensure pollution risks to soil, waterways and air quality are avoided or minimised. In the event of a pollution incident that causes or threatens material harm to the environment, the NSW EPA would be notified.

The legal requirements for waste management are also established under the POEO Act and the *Protection of the Environment Operation (Waste) Regulation 2005* (POEO Waste Regulation). Under section 143 it is an offence to unlawfully transport and dispose of waste.

Waste minimisation and management is discussed in Section 8.10.

5.3.19 Biosecurity Act 2015 (Biosecurity Act)

The Biosecurity Act repealed the *Noxious Weeds Act 1993* and provides a framework for the prevention, elimination and minimisation of biosecurity risks posed by biosecurity matter, dealing with biosecurity matter, carriers and potential carriers, and other activities that involve biosecurity matter, carriers or potential carriers.

Part 3 of the Biosecurity Act applies a general biosecurity duty for any person who deals with biosecurity matter or a carrier to prevent, eliminate or minimise any biosecurity risk they may pose. Under section 23 of the Act, a person who fails to discharge a biosecurity duty is guilty of an offence.

Whilst the Act provides for all biosecurity risks, implementation of the Act for weeds is supported by Regional Strategic Weed Management Plans (RSWMP) developed for each region in NSW. Appendix 1 of each RSWMP identifies the priority weeds for control at a regional scale. However, landowners and managers must take appropriate actions to reduce the impact of problem weed species regardless of whether they are listed in Appendix 1 of the RSWMP or not as the general biosecurity duty applies to these species.

Five priority weeds were identified within the Project Site during the FBA process (Section 8.4). Weed management will be incorporated into the EMS, prioritising priority weeds with the Development Footprint.

5.3.20 Rural Fires Act 1997 (Rural Fires Act)

The Rural Fires Act provides for the preparation, mitigation and suppression of bush and other fires in local government areas and to provide protection of infrastructure and environment, economic, cultural, agricultural and community assets from damage arising from fire.

The Project Site contains pockets of Bushfire Prone Land as mapped on the ePlanning Spatial Viewer Bushfire Prone Land Map (Wellington Council, 2013). However, the Project is not a subdivision for residential or rural residential purposes nor is it for a special fire protection purpose, hence issue of a bush fire safety authority under section 100B of the Rural Fires Act is not required. Furthermore, a section 100B authority is not required pursuant to section 4.41 of the EP&A Act. Fire risk is further discussed Section 8.6.8.

5.3.21 Waste Avoidance and Resource Recovery Act 2001 (WARR Act)

The WARR Act introduces a scheme to promote extended producer responsibility for the life-cycle of a product. The objectives of the WARR Act are:

(a) *to encourage the most efficient use of resources and to reduce environmental harm in accordance with the principles of ecologically sustainable development,*

(b) *to ensure that resource management options are considered against a hierarchy of the following order:*

(i) *avoidance of unnecessary resource consumption,*

(ii) *resource recovery (including reuse, reprocessing, recycling and energy recovery),*

(iii) *disposal,*

(c) *to provide for the continual reduction in waste generation,*

(d) *to minimise the consumption of natural resources and the final disposal of waste by encouraging the avoidance of waste and the reuse and recycling of waste,*

(e) *to ensure that industry shares with the community the responsibility for reducing and dealing with waste,*

(f) *to ensure the efficient funding of waste and resource management planning, programs and service delivery,*

(g) *to achieve integrated waste and resource management planning, programs and service delivery on a State-wide basis,*

(h) *to assist in the achievement of the objectives of the* Protection of the Environment Operations Act 1997.

Waste minimisation and management in accordance with the WARR Act is considered in more detail in Section 8.10.

5.3.22 Mining Act 1992 (Mining Act)

The objective of the Mining Act is to encourage and facilitate the discovery and development of mineral resources in NSW, having regard to the need to encourage ESD.

The Project Site includes land identified within exploration licences and applications over the Site (further detail is provided in Section 8.9.

5.4 Local Planning Instruments

As identified in Section 5.1, the Site is located within the Dubbo Regional Council LGA which was formed following the amalgamation of the Wellington and Dubbo Shire Councils in 2016. The land on which the WTGs and Ancillary Infrastructure are proposed to be located is within the former Wellington Council LGA to which the Wellington LEP applies.

The Project is entirely situated on land zoned as RU1 Primary Production (Figure 5-1) under the Wellington LEP. Wind energy systems are prohibited in the RU1 Zone. However, pursuant to clause 34(1b) of the ISEPP, development for the purpose of electricity generating works may be carried out by any person with consent on any land in a prescribed rural, industrial or special use zone. Given that the Project is located on prescribed rural land, and the proposed activity is to generate electricity from wind, the Project is permissible with consent.

Council has undertaken an operational review of the Wellington LEP which contains several housekeeping amendments (none of which apply to the Project). The Planning Proposal has recently been submitted to DPIE with a request for drafting.

Council is also in the process of consolidating provisions under both the Dubbo Shire LEP 2011 and the Wellington LEP to prepare a new LEP for the Dubbo Regional LGA which was amalgamated in 2016. The Planning Proposal has not yet been submitted to DPIE.

The Project Site is subject to the Wellington Development Control Plan (DCP). The Wellington DCP provides development standards and guides local development in terms of building design, landscaping, car parking, heritage and stormwater management, among others, but does not contain any specific provisions relevant to large scale wind farm developments.

Section 3.42 (1) of the EP&A Act states the principal purpose of DCPs is to provide ‘guidance’ to development proponents and consent authorities and to assist ‘facilitating development that is permissible’. Accordingly, local provisions under the relevant DCP are not statutory requirements.

No planning (or draft planning) agreements related to the Project have been (or may be) entered into under section 7.4 of the EP&A Act.

5.5 Summary of Licences and Approvals Required

A summary of approvals and licences that may be required for the Project prior to construction are outlined in Table 5-2 (including but not limited to).

Table 5-2: Approvals and licences required for the Project

Legislation	Approval/Licence
Roads Act 1993	Section 138
Crown Land Management Act 2016	Part 5 Division 5.6 – Licences over Crown Land
Protection of the Environment Operations Act 1997	Section 48

Although all relevant environmental impacts have been assessed in this EIS, due to the Project's nature and being SSD, there are several approvals and licences not required, which are outlined in Table 5-3.

Table 5-3: Approvals and licences not required for the Project

Legislation	Approval/Licence
Fisheries Management Act 1994	Section 201
	Section 205
	Section 219
Water Management Act 2000	Section 91
Heritage Act 1977	Section 139
National Parks and Wildlife Act 1974	Section 90

6 Stakeholder and Community Consultation

6.1 Commitment

The Proponent has consulted with the local community since 2011, taking on advice and seeking to avoid, minimise and mitigate potential impacts in accordance with community and stakeholder consultation. Accordingly, the project design has changed extensively through these consultation processes. The outcomes of community consultation to date are distilled within this EIS, however, the process will continue throughout the exhibition, response to submission and approval process. The Proponent remains committed to an open and transparent process that maximises public good, while minimising negative impacts and undue burden on certain parts of the community and/or individuals.

Community awareness and input are fundamental to responsible and sustainable development. CWPR understands the importance of effective and broad community consultation and aims to genuinely engage with all stakeholders interested in or impacted by the Project. CWPR has formally committed to honouring the Clean Energy Council's (CEC) Community Engagement Best Practice Charter. The Charter is a set of voluntary commitments to engage respectfully with the communities in which they plan and operate projects, to be sensitive to environmental and cultural values and to make a positive contribution to the regions in which they operate.

CWPR is committed to sharing the benefits of the Project with the community and a description is provided later in the Section of the Project's approach to direct community benefits funding, as well as the approach CWPR is considering regarding community co-investment (industry-recognised as an innovative approach pioneered by CWPR on its now operational Sapphire Wind Farm project, recognised in *A Guide to Benefit Sharing Options for Renewable Energy Projects* (Lane and Hicks 2019)).

This section describes the approach in consultation on the Project during the development timeline from the initial public announcement of the Project in 2011 through to this EIS. It describes:

- the general principles and approaches to consultation developed and adopted during the development (Section 6.2);
- the process of stakeholder identification (Section 6.3);
- consultation activities methods and timeline (Section 6.4);
- responses and adaptations made by the Project based on feedback (Section 6.5); and
- community benefit sharing (Section 6.6).

The design evolution of the Project and impact minimisation has been previously discussed in Section 2.7.

Public consultation for the Project commenced in March 2011 during the early stages of planning and feasibility assessment for the Project. Consultation with the local community has been underway ever since. The approach has been to share information about the Project with the public, neighbouring residents, statutory regulators and other stakeholders, listen to community feedback and amend the proposal where possible to address concerns.

The Proponent has carried out extensive consultation with the local community, stakeholders from the wider area and relevant government agencies in order to understand and respond to community concerns during the design and assessment process leading to this Development Application. Consultation on the Project will not cease with the submission of this EIS, with consultation activities ongoing at the time of preparing this EIS.

6.2 Consultation Principles: Community Engagement Planning

6.2.1 What is Community Engagement

'Community Engagement' is a planned process with the specific purpose of working with identified groups of people, whether they are connected by geographic location, special interest, affiliation or identity to address issues affecting their well-being. The linking of the term 'community' to 'engagement' serves to broaden the scope, shifting the focus from the individual to the collective, with the associated implication of inclusiveness to ensure consideration of the diversity that exists within every community.

6.2.2 Aim and Objectives of Community Engagement

Genuine community engagement and social responsibility form the basis from which a social licence to operate can be established and effective relationships formed. Implementation of the community engagement for the Project is focused around the following mission statement, supporting objectives (Table 6-1) and the public participation spectrum considerations (Figure 6-1) for the Project.

"Successful community engagement is built upon cooperation, integrity and trust. This is achieved through delivery on promises to the community and genuine engagement with all stakeholders, with a long-term objective to build a culture of support beyond acceptance."

Table 6-1: Uungula wind farm community engagement objectives

Uungula Wind Farm Community Engagement Objectives
Deploy a community engagement model to inform, consult, involve, collaborate and empower stakeholders and local communities (Table 6-2).
Inform and influence community attitudes to Uungula Wind Farm.
Document community engagement activities and outcomes on an ongoing basis.
Position Uungula Wind Farm as 'the Australian model of community engagement'.
Maintain clear and consistent messaging across all publications and platforms.

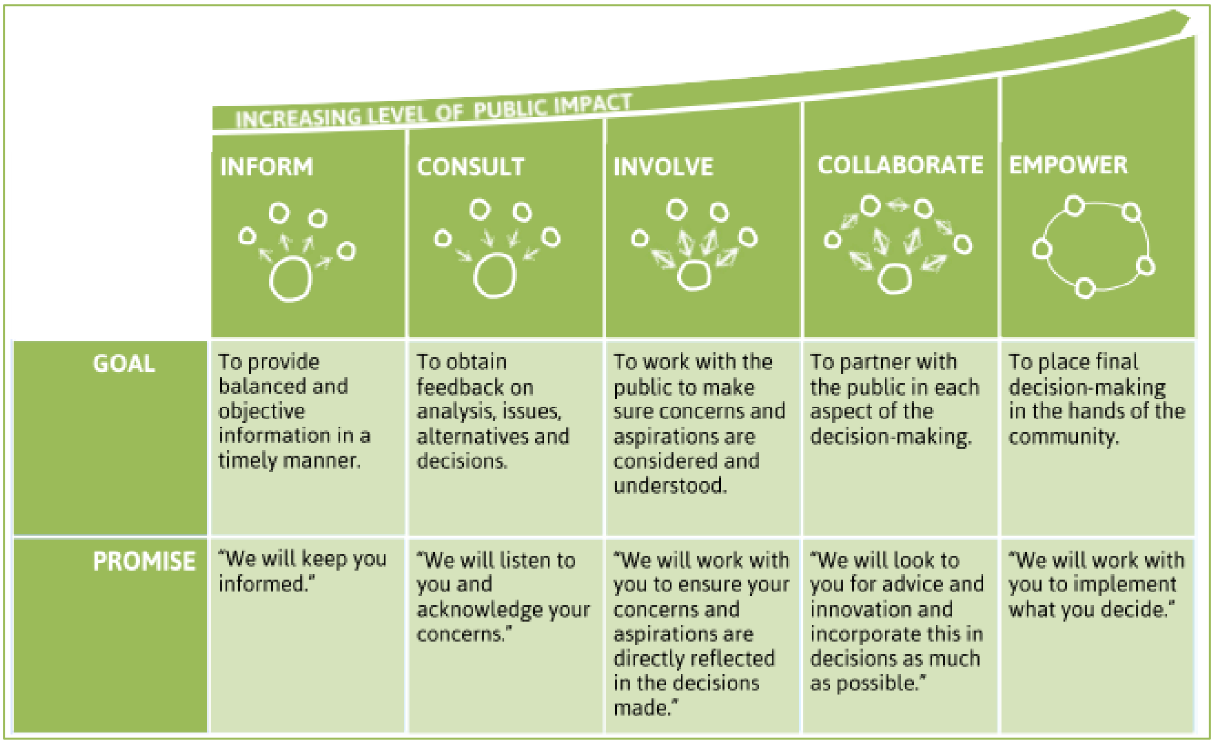


Figure 6-1: IAP2 public participation spectrum (as adapted from Lane and Hicks, 2014)

6.2.3 Principles of Community Engagement

In seeking to deliver on key aims and objectives, adherence to and respect of core principles is vital. The principles that drive the consultation approach are detailed in Table 6-2 (as adapted from Lane and Hicks (2014)) and are ubiquitous throughout the development history of the Project. These principles will continue to be reflected through Project progress and are referenced throughout this section.

Table 6-2: Community engagement guiding principles

Community Engagement Guiding Principles	
Mutual Benefit	Create shared outcomes of mutual benefit for the local host community, landowners and development.
Mutual Respect	Allow for genuine dialogue to take place and opportunities for community members to participate in respectful discussions.
Relationship-building	Building local networks and relationships, leading to trust, advocacy and continual improvement.
Authenticity	Dedicated personnel, genuine understanding, delivery of promises, and listening to local views.
Appropriateness	Being adaptive and scaling the Project to the local context.
Ongoing engagement	Seeking and maintaining a culture of support for the Project beyond acceptance through whole-of-life engagement practices.
Transparency	Open communication across all aspects of the Project and process.
Responsiveness	Timeliness in communicating a response to emerging issues or opportunities.

6.3 Stakeholder Identification

The Proponent has identified several stakeholder groups who have been consulted with as part of the development of the Project and as required by the SEARs including:

- Local residents and landowners within 8 km of the proposed WTGs (engaged as a priority);
- Local residents who live along the proposed transport route;
- Wellington Valley and Gallanggabang Aboriginal Corporations;
- Dubbo Regional Council (and previous Wellington and Mid-Western Regional Councils);
- OEH (now BCD within DPIE);
- Department of Industry - Resources and Energy;
- DPI (Office of Water, Fisheries and Agriculture);
- Roads and Maritime Services (RMS) - Western Region (now Transport for NSW);
- Central Tablelands Local Land Services;
- NSW Rural Fire Service (RFS) including local volunteers;
- DoD;
- CASA;
- AsA; and
- Minerals Title holders (Endeavour Minerals Pty Ltd, Drummond West Pty Ltd, Syndicate Minerals Pty Ltd, and Monzonite Metals Pty Ltd).

The process of identification of and engagement with stakeholders is ongoing as the project progresses.

6.4 Consultation Activities Methods and Timeline

Public consultation on the Project commenced when the Proponent submitted a draft PEA for the Project to the NSW DPE in March 2011. In response, the DPE issued Director-General's Requirements (DGRs) on 14th April 2011. Supplementary DGRs were issued on 16 August 2011 with additional requirements for community consultation. The revised PEA was submitted in November 2016 in response to a request from DPE to provide an updated PEA so that agencies can provide relevant input to the SEARs. The SEARs were reissued in December 2016.

A draft EA was prepared and submitted to DPE for adequacy review in May 2013. SEARs were subsequently issued on 21st December 2016 following the Project's transition to Part 4 SSD and based on the updated PEA submitted in November 2016.

Changes to the project design in late 2018 including increasing the maximum tip height from 200 m to 250 m as well as the inclusion of an ESF have been discussed with DPIE. Consultation with neighbours surrounding the development, and the re-established CCC of the potential changes. An extension of the EIS exhibition timeframe as granted by DPE following discussions in November 2018, regarding the proposed increase in WTG height and the Proponent's request for more time to engage with the community regarding the changes.

A community consultation plan was prepared to address the requirements of the *NSW Wind Energy Guideline (2016) and the Wind Energy: Visual Assessment Bulletin* (the Visual Assessment Bulletin) prepared by DPE.

The DPIE were consulted further during 2019 regarding the addition of the proposed ESF and revision of the layout within the same general area. The DPIE issued revised SEARs in November 2019 that included clear requirements for consideration of the ESF as well as an additional request to undertake a route study from the proposed port of entry to the Project Site. The SEARs are intended to guide the structure and content of the EIS and reflect the responsibilities and concerns of NSW government agencies in relation to the environmental assessment of the Project.

A summary of key issues raised in the SEARs and the section of the EIS where they are addressed is provided in Table 1-1. In addition to the SEARs, additional issues raised by statutory agencies through formal correspondence attached to the SEARs are summarised in Table 6-3, together with the relevant section which addresses that issue in the EIS.

Table 6-3: Key issues raised by statutory agencies for the Project

Agency	Issues raised	Section in EIS
Airservices	All wind farm proposals submitted to Airservices must include an Aviation Impact Statement (AIS) prepared by an aeronautical consultant in accordance with the AIS criteria set out below. The AIS must be undertaken by an aeronautical consultant with suitable knowledge and capabilities to provide a reliable and comprehensive report. **AIS Criteria** The AIS must provide a detailed analysis covering, as a minimum: • Airspace Procedures: ○ Obstacles – Co-ordinates in WGS 84 (to 0.1 second of arc or better) – Elevations in metres (m) Australia Height Datum (AHD) (to 0.3m) ○ Drawings – Overlayed on topographical base not less than 1:250,000. Details of datum and level of charting accuracy to be noted. – Electronic format compatible with Microstation version V8i. ○ Aerodromes – Specify all registered/certified aerodromes that are located within 30NM (55.56km) from any obstacle referred to in (1) above. – Nominate all instrument approach and landing procedures at these aerodromes. – Confirmation that the obstacles do not penetrate Annex 14 or Obstacle Limitation Surface (OLS) for any aerodrome. If an obstacle does penetrate, specify the extent. ○ Air Routes – Nominate air routes published in ERC-L & ERC-H which are located near/over any obstacle referred to in (1) above. – Specify two waypoint names located on the routes which are located before and after the obstacles.	8.6.2 and Appendix O

Agency	Issues raised	Section in EIS
	○ Airspace – Airspace classification – A, B, C, D, E, G etc where the obstacles are located. • Navigation/Radar: ○ Detect the presence of dead zones ○ False target analysis ○ Target positional accuracy ○ Probability of detection ○ Radar coverage implications ○ We would expect the analysis to follow the guidelines outlined in the latest version of the EUROCONTROL Guidelines on How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors: https://www.eurocontrol.int/tags/guidelines	
Division of Biodiversity Conservation within DPIE	BCD understands that the environmental assessment for the project was substantially commenced before the commencement of the *Biodiversity Conservation Act 2016*. The environmental assessment for biodiversity is therefore considered a 'pending or interim planning application' under clause 27 (1)(d) of Part 7 of the *Biodiversity Conservation (Savings and Transitional) Regulation 2017*. The project application must be submitted by 11 July 2020. As a transitional assessment, the biodiversity assessment will be assessed in accordance with the NSW Biodiversity Offsets Policy for Major Projects and the Framework for Biodiversity Assessment. There are no changes required to the SEARs advice provided by the Office of Environment and Heritage to the Department of Planning and Environment in November 2016.	8.4
Division of Resources and Geoscience within DPIE	The Draft Revised SEARs require the proponent to address the projects potential land use conflicts with existing and future surrounding land uses. These include mining, mineral and petroleum rights. The Draft SEARs should also include the requirement for consultation during the preparation of the Environmental Impact Statement (EIS) with exploration licence holders, quarry operators and mineral title holders. The proponent should identify any of the above in the EIS and consult with the operators or title holders to establish if the proposal is likely to have a significant impact on current or future extraction of minerals, petroleum	3.5.7 and 8.9.3.1

Agency	Issues raised	Section in EIS

	or extractive materials (including by limiting access to, or impeding assessment of resources). The EIS should also document any way the proposed development may be incompatible with existing or approved uses, or current or future extraction or recovery of resources under the land use compatibility requirements of Part 3(13) of the Mining SEPP.
	In fulfilling the SEARs relating to the State's mineral resources and rights to assess and extract those resources, the Division requires the following project specific requirements to be addressed in the EIS:
	• The proponent should undertake a dated and referenced search for any new mineral, coal and petroleum title applications over or adjacent to the proposal site during the preparation of the EIS. Evidence of the search should be provided in the form of a date referenced map. Current mining and exploration titles and applications can be viewed through the Division's MinView map viewer at: http://www.resourcesandenergy.nsw.gov.au/miners-and-explorers/geoscience-information/services/online-services/minview
	• The proponent should contact the titleholders to determine their level of interest and provide authentic consultation to the Division. This should include a letter of notification of the proposal to the title holder including a map indicating the wind farm proposal area (and associated electricity transmission infrastructure) in relation to the exploration title boundaries, and a letter of response from the title holder to the proponent. If responses are not received from the titleholders, the proponent is to contact the Division.
	• The Division has identified the Mining Act 1992 authorities detailed below which intersect with the project area. The title holder contact details are:
	  ○ EL 8212 and EL8252 - Endeavour Minerals Pty Ltd
	  ○ EL8505 – Drummond West Pty Ltd
	  ○ ELA 5852 – Syndicate Minerals Pty Ltd
	  ○ ELA 5857 – Monzonite Metals Pty Ltd
	• The proponent should check for new mineral and energy titles that may be granted in the vicinity of the subject site during all decision-making stages of the project. This is to ensure that other stakeholders with interests in the subject area are made aware of the wind farm project.	

Agency	Issues raised	Section in EIS
	• Should biodiversity offsets be considered, GSNSW requests to be consulted in relation to the proposed location of any biodiversity offset areas or any supplementary biodiversity offset measures to ensure there is no consequent reduction in access to prospective land for mineral exploration, or potential for sterilisation of mineral resources.	
Division of Water within DPIE and NRAR	The SEARs should include: • The identification of an adequate and secure water supply for the life of the project. This includes confirmation that water can be sourced from an appropriately authorised and reliable supply. This is also to include an assessment of the current market depth where water entitlement is required to be purchased. • A detailed and consolidated site water balance. • Assessment of impacts on surface and ground water sources (both quality and quantity), related infrastructure, adjacent licensed water users, basic landholder rights, watercourses, riparian land, and groundwater dependent ecosystems, and measures proposed to reduce and mitigate these impacts. • Proposed surface and groundwater monitoring activities and methodologies. • Consideration of relevant legislation, policies and guidelines, including the NSW Aquifer Interference Policy (2012), the Guidelines for Controlled Activities on Waterfront Land (2018) and the relevant Water Sharing Plans	8.9 and Appendix P

6.4.1 Stakeholder Engagement Methods

The approach to consultation throughout the development process has been focused on enabling transparency regarding the project planning and open methods of communication between stakeholders and the Proponent. During the planning of the Project, regular communication with stakeholders has been maintained and the proponent has actively sought opinions about the project and community values through multiple communication channels including the CCC, project website and face-to-face meetings.

The Proponent has provided a number of options and methods to actively engage with stakeholders who may be interested or impacted by the project to ensure project information is available, timely and easy to understand. The Proponent has had a strong focus on consultation efforts with non-involved landowners living within 5 km of proposed WTG locations as well as those along Twelve Mile Road who may be impacted during construction. The Project development team create and maintain a detailed summary of potential impacts from the Project to each unique residence within 8 km, based on the content of the technical impact assessment work, as well as noting the concerns of those residents gathered during consultation.

6.4.1.1 Face to Face Meeting

The Project development team have undertaken face to face meetings since the initial public announcement of the Project in 2011. These are undertaken as a means of sitting and discussing the Project together in a respectful and unhurried manner. The meetings provide the opportunity for the Project development team to understand the stakeholders' prevalent and concerning issues and take that feedback to respond in the iterative design process for the Project. The Project development team initiate meetings to visit stakeholders and discuss the Project or at the request of stakeholders are regularly available for face to face meetings.

6.4.1.2 Phone Calls

The Project development team contact stakeholders by phone to discuss elements of the Project and disseminate information. This is often used as a means to organise meetings or provide clarity on minor matters, although the Project development team are readily available for face to face meetings and use phone calls more as a tool to organise those meetings. Some stakeholders may prefer to have meetings over the phone rather than in person.

6.4.1.3 Email Exchange

Emails are a tool used for the discussions with particular stakeholders where this is a practical means of interaction, however not as a replacement for the above face to face meetings or phone calls. These are a very useful tool in the sharing of Project information.

6.4.1.4 Letter (physical)

Letters have been used as a means of contacting people with general updates or in a targeted manner with information on a particular topic specific to a group of residents in an area. These provide a means of contact where residents are not contactable via any other means. The letters contain contact details of the Project development team to allow further discussion.

6.4.1.5 Newsletter (physical)

The distribution of physical newsletters was typically conducted to a targeted physical audience of recipients in a region relative to the Project. These were typically two-sided, double paged A4 sized, booklet style providing information on the current status of the Project's development. These always included contact details of the CWPR development manager for further discussion and correspondence.

See Appendix Q with copies of all of the newsletters distributed to the community to date.

6.4.1.6 Newsletter (electronic)

Electronic newsletters accompanied the release of the physical newsletters. This platform enabled the sharing of the information contained in the physical newsletters to a wider audience and those stakeholders comfortable with the viewing of Project information online.

6.4.1.7 Public Meetings / Open days

The Project has held public meetings in the form of open days as a means of providing the public an informal avenue to discuss Project information or allow interested stakeholders peruse information developed on poster boards around the room. These are typically 'drop-in' style open door meetings held at a convenient and accessible location where the Proponent makes available key staff to discuss aspects of the Project. The Project has also attended public meetings called by other stakeholders as a means of discussing and disseminating Project information.

6.4.1.8 Website Users

The Project maintains a website providing accessible information to the public on:

- Description of the Project;
- The timeline of the Project;
- Project planning and approvals process, including publicly available planning documents;
- Community engagement, including all CCC presentations and minutes;
- Project updates, newsletters, media releases;
- Information about the Proponent, including links to CWP Renewables website and social media;
- Contractor enquiries form, encouraging local contractors and services providers to register their interest in supplying goods and services during construction and operation of the wind farm;

- Contact Us page with contact form, as well as Development Manager contact details (phone, email and postal address; and
- Contact details and mailing list subscription form at the bottom of every page.

See Appendix Q with example screenshots from the Project website.

6.4.1.9 Print Media

The Project has participated in requests from the media to provide comments or an interview for particular articles. Media releases were sent to local media outlets with regular Project updates.

Local Media Outlets:

- Mudgee Guardian and Gulgong Advertiser;
- The Western Advocate;
- Wellington Times;
- The Land; and
- Newcastle Herald.

6.4.1.10 Radio/TV

The Project has participated in requests from the media to provide comments or an interview for particular stories being run.

- Radio 2MG, Mudgee;
- ABC Central West; and
- Prime Television.

6.4.2 Approaches Specific to Landscape and Visual Impact Assessment

The consultation and impact assessment of wind projects in NSW must consider some wind industry-specific statutory guidelines which mandate landscape values surveys and magnitude thresholds for visual assessments. The methods and results are described in specific detail in Section 8.2 and Appendix R, although the approaches in using them as consultation tools are described in the following subsections.

6.4.2.1 Landscape Values Survey

Consultation with the community regarding the landscape and visual impact of the project has been ongoing. The aim to understand the value that the community places on the landscape features, areas of scenic quality in order to understand the community landscape value according to the Visual Assessment Bulletin (DPE, 2016b).

Two surveys were conducted to allow the community to rank the features of scenic quality.

6.4.2.2 Magnitude Thresholds for Visual Assessment

Key stakeholders have been identified using the Visual magnitude threshold for visual assessment tool provided in the Visual Assessment Bulletin (DPE, 2016b). In developing the revised layout, the visual magnitude tool was assessed using a 250 m tip height. In accordance with Figures 2 and 5 of DPE (2016a), detailed consideration has been given to all residences within 3.35 km of a WTG and mitigation measures considered for all residences within 5 km. The Proponent has discussed impacts and mitigations and offered neighbour agreements to all non-associated residences identified as requiring mitigation as described in Section 8.2.

6.4.3 Detailed Consultation Activities and Outcomes

Initial consultation and negotiation with host landowners began in 2008 during the site identification and resource monitoring phase.

Since receiving updated SEARs in 2016, the Project has undertaken a significant design review. The Project was significantly revised in July 2018 to remove all proposed WTGs and other infrastructure from east of the Cudgegong River (i.e. the Yarrabin and Piambong areas). This decision was based on a detailed review of the grid network and extensive consultation with landowners and neighbours to the proposed Project.

Table 6-4 outlines the detailed list of consultation activities over the Project development timeline since the first public announcement of the Project in 2011. It describes the stakeholders identified (as described in Section 6.3), the consultation methods employed (as described in Section 6.4.1), the activities undertaken and the outcomes and impact on the Project. The latter are detailed further in Sections 6.5 and 2.7.

Table 6-4: Detailed consultation activities timeline and outcomes

Date	Stakeholder	Method: Face to Face Meeting	Phone Call	Email Exchange	Letter (physical)	Newsletter (physical)	Newsletter (electronic)	Public Meeting / Open Day	Survey (physical)	Survey (electronic)	Website Users	Print Media	Radio/TV	Activity / Outcome	IAP2 spectrum level
2011-ongoing	Neighbours and local residents	x				x								Project announced with newsletters and door knocking. Ongoing consultation to keep stakeholders informed and understand concerns	inform, consult
2011-ongoing	Neighbours and local residents								x	x				3x Public Opinion Surveys since 2011 seeking feedback from the local community to understand the landscape features and scenic values of the region.	consult
2011-ongoing	Local Media Outlets: Mudgee Guardian and Gulgong Advertiser Wellington Times The Western Advocate Radio 2MG Mudgee ABC Central West Prime television Newcastle Herald											x	x	Media releases to local media outlets to announced project and provide information about the proponent	inform
2011-ongoing	Internet users										x			Website established with regular updates and media releases, direct contact details, e-newsletter signup, contact forms, contractor enquiry form, have your say page to keep all interested parties informed about the Project. Gather feedback or questions through online enquiry forms.	inform, consult
Early 2012	Neighbours and local residents	x						x						Community Open Day held in Goolma (attended by almost 100 people). Display and discuss aspects of the proposed development and capture feedback from the local community that will assisted in shaping the project	inform, consult
2013	Community Consultative Committee: 8x Community Representatives Mayor, (then) Wellington Council General Manager, (then) Wellington Shire Council Group Manager, Development and Services, (then) Mid-Western Regional Council Councillor, Mid-Western Regional Council	x												Community Consultative Committee established prior to the 2013 submission of the EIS. Three meetings were held (February, June, and September 2013). The purpose of the CCC is to provide a forum for open discussion between representatives of the company, the community, the council and other stakeholders on issues directly relating to the project's development, construction, operations, environmental performance and community relations, and to keep the community informed on these matters.	consult, involve
2013	Hosts and neighbours							x						Tour of Crookwell Wind Farm during construction to help increase awareness and understanding of what is involved in wind farm construction and operations. Answer questions and hear concerns	inform, consult
2013	Local Landcare groups							x						Consulted with local Landcare groups and participated in 'Green Day 2013' Mudgee event - Slideshow presentation and 'Make a WTG' activity for primary school students. The Project team showed WTGs from around the world and explained how WTGs capture the energy. Increase public awareness about renewable energy and proposed projects in the region	inform, consult

Date	Stakeholder	Method												Activity / Outcome	IAP2 spectrum level
		Face to Face Meeting	Phone Call	Email Exchange	Letter (physical)	Newsletter (physical)	Newsletter (electronic)	Public Meeting / Open Day	Survey (physical)	Survey (electronic)	Website Users	Print Media	Radio/TV		
2013	Title Holders of mineral exploration leases and mining licences within the study area: • Ironbark Zinc Ltd • Alkane Resources Ltd • Oroya (NEO Resources Ltd)			x										Consulted with Title Holders of mineral exploration leases and mining licences within the study area	consult
2013-ongoing	Neighbours and local residents	x	x	x	x									Direct visits to landowners who may be affected by the project to discuss potential impacts. General updates sent via physical and electronic newsletters	inform, consult
	Neighbours and local residents						x				x			9 x e-newsletters sent to approximately 150 subscribers since 2011. Available on Website	inform
2013-ongoing	Registered Aboriginal Parties (RAPs) Wellington Valley Wiradjuri Aboriginal Corporation Galanggabang Aboriginal Corporation Wiradjuri traditional Owners Central West Aboriginal Corporation	x		x										RAPs input. Consultation with the local Aboriginal community through the preparation of a Cultural Heritage Assessment. Project updates ongoing since 2013	involve
2013-ongoing	Media users											x	x	Media coverage at the local and regional scale	inform
2013 – ongoing	Local Councils ((then) Wellington Council and Mid-Western Regional Council)	x		x										Local Government consultation	consult, involve
2013 – ongoing	NSW Government and Agencies													State Government consultation through environmental planning and permitting process assessment	consult, involve
2014	Small Farm Field Days							x						Exhibited the Project and company at Small Farm Field Days Mudgee Increase public awareness and answer questions regarding the projects in the area and provide information about the Proponent.	inform, consult
January 2017	Commonwealth Department of Environment and Energy			x										Consultation undertaken seeking to clarify the assessment pathway of the Project as a ‘controlled action’. Department confirmed the Project as a controlled action could be assessed under the bilateral accredited assessment process between NSW and the Commonwealth Governments.	inform, consult

Date	Stakeholder	Method												Activity / Outcome	IAP2 spectrum level
		Face to Face Meeting	Phone Call	Email Exchange	Letter (physical)	Newsletter (physical)	Newsletter (electronic)	Public Meeting / Open Day	Survey (physical)	Survey (electronic)	Website Users	Print Media	Radio/TV		
2017 – ongoing	Rural Fire Services (local region)	x	x	x										Provide project updates and gather input from the local RFS	inform, consult
Early 2018 - ongoing	Internet users										x			Website revitalized in early 2018 with more advanced information and more user-friendly interface. Email newsletter sent to subscribers A general project update providing information to the community on the process for reviewing the Project layout and future consultation going forward.	inform, consult
July 2018	Mid-Western Regional Council Mayor			x										Email with letter attached sent to the Mayor of Mid-Western Regional Council notifying of the Project's proposed reduction to remove infrastructure from the Mid-Western Regional Council LGA	inform
Mid 2018 – ongoing	Community Consultative Committee	x												Community Consultative Committee re-advertised and re-established, meetings held quarterly and ongoing to present (5 meetings held since 2018) provide a forum for open discussion between representatives of the company, the community, the council and other stakeholders on issues directly relating to the project's development, construction, operations, environmental performance and community relations, and to keep the community informed on these matters.	consult, involve
Mid 2018 – ongoing	Residents within 5km	x	x	x		x								Direct contact with all residents within 5km to discuss the Project	consult
Mid 2018 – ongoing	Residents between 5km and 8km	x				x	x				x			3x Newsletters mailed to all dwellings within 8km and along the transport route (on the local road network). Provide general Project update and contact details. Newsletter content also sent to email subscribers and made available on website	inform
Late 2018	Wider community					x	x							Community landscape values survey distributed via email and posted seeking feedback on community landscape and scenic quality values. 3x reminders sent.	consult
Late 2018 – early 2019	Office of Environment and Heritage (Dubbo Region)	x	x	x										Liaison with regional Office of Environment and Heritage regarding use of existing data for this EIS submission and the suitable assessment pathway. Liaison confirmed existing data was suitable with some supplementation and that the project should be assessed under the Framework for Biodiversity Assessment.	Inform, consult

Date	Stakeholder	Method												Activity / Outcome	IAP2 spectrum level
		Face to Face Meeting	Phone Call	Email Exchange	Letter (physical)	Newsletter (physical)	Newsletter (electronic)	Public Meeting / Open Day	Survey (physical)	Survey (electronic)	Website Users	Print Media	Radio/TV		
Late 2018	Mayor of Dubbo Regional Council	x												Discuss transport and traffic impacts, socio-economic impacts and voluntary planning agreements	consult
	Wellington Chamber of Commerce	x												Sharing project information with Wellington and Dubbo Chamber of Commerce members. Keep members informed about the Project and discuss opportunities for benefit sharing within the local business community	inform, consult
Early 2019 – ongoing	Local community groups: Police Citizens Youth Club (PCYC) Aboriginal Employment Strategy Local education providers (TAFE, CSU) Local businesses and service providers	x		x										Met with local Wellington community groups to discuss opportunities for partnership/participation as part of the local enhancement fund contributions. Discussions are ongoing and the proponent is working with Dubbo Regional Council to consider how to initiate and support community initiatives as part of the Project.	
Mid 2019	RMS	x	x	x										Meeting to brief Roads and Maritime Services (RMS) Western Division Director and Special Permits division regarding route study and over-size over-mass (OSOM) vehicles in Glen Innes. Discussions involved a description of the process, and there was a general acceptance of the proposed approach to further analysis, traffic and transport investigations, road capacity assessments and permitting which has been followed in preparing this EIS. Followed up with provision of the Project's route study and summary of manoeuvres required along the route.	
Mid 2019	Title Holders of mineral exploration leases and mining licences: • Endeavour Minerals Pty Ltd • Drummond West Pty Ltd			x										Update Title Holders of mineral exploration leases and mining licences with regarding the project timeline and change to study area	consult
Late 2019 and early 2020	Crown Lands	x	x	x	x									Application and consultation regarding the licensing process	
Late 2019 – ongoing	Dubbo Regional Council Director and Manager of Infrastructure Services	x	x	x										Consultation regarding resource requirements (e.g. water and quarry material) and proposed transport access arrangements	
	NSW Aboriginal Land Council		x	x	x									Consultation regarding Crown Lands and land claims	

Date	Stakeholder	Method												Activity / Outcome	IAP2 spectrum level
		Face to Face Meeting	Phone Call	Email Exchange	Letter (physical)	Newsletter (physical)	Newsletter (electronic)	Public Meeting / Open Day	Survey (physical)	Survey (electronic)	Website Users	Print Media	Radio/TV		
	Dubbo Regional Council's Local Emergency Management Coordinator	x	x	x										Consultation regarding Project's approach to emergency management processes. Project personnel were added to emergency management contact lists in the Local Emergency Management Committee. Project team were invited to attend LEMC meeting prior to construction. Project will maintain communications with LEMC coordinator and first responders during preparation for construction (including undertaking site tours)	
	Rural Fire Service (Dubbo)		x											Phone calls to discuss the Project and local RFS shed plans. General agreement to continue discussions as the Project came closer to construction	
Late 2019 – early 2020	Neighbours and local residents	x	x	x										Direct neighbour consultation based on project layout changes and impact assessment. Ensure stakeholders are aware of EIS submission plan and assessment process (including their opportunity to make comment).	
	Residents on Twelve Mile Road access route	x	x	x	x									Direct consultation with residents to discuss proposed road upgrades and potential impacts	
	Residents located on Twelve Mile Road				x									Letter to residents located on Twelve Mile Road (Project main access) and surrounding roads regarding traffic and transport	
January 2020	Mayor of Dubbo Regional Council and senior management team: Community Support Officer Director, Liveability CEO Director, Planning and Environment	x												General Project briefing including discussion of Project layout, development application process, transport, traffic, resource requirements, and community benefit sharing	
February 2020	NSW Farmer's Association Wuuluman Branch: NSW State Member Dugald Saunders Dubbo Regional Council Deputy Mayor Councillor Media (The Land newspaper) RMS Transport for NSW area manager land use assessment engineer Local community members	x						x				x		Attendance at a public meeting held by in Wellington regarding the proposed upgrade and use of Twelve Mile Road (approximately 50 attendees). Q&A forum, the Project team were questioned from local community members regarding the proposed upgrade and use of Twelve Mile Road	consult, involve
March 2020	CASA Airservices Australia Department of Defence			x										Emailed agency the aviation assessment (appendix to this EIS) and offered to meet to discuss the findings. CASA responded that they would take direction from the DPIE during the public exhibition. Airservices Australia commenced an assessment. No response received from Department of Defence.	inform, consult, involve
March 2020	DPIE – NRAR & Water Central West LLS			x										Emailed agencies regarding the Project, offering a briefing and discussion of the findings. No responses received at time of EIS publication.	inform, consult, involve

Date	Stakeholder	Method: Face to Face Meeting	Phone Call	Email Exchange	Letter (physical)	Newsletter (physical)	Newsletter (electronic)	Public Meeting / Open Day	Survey (physical)	Survey (electronic)	Website Users	Print Media	Radio/TV	Activity / Outcome	IAP2 spectrum level
March 2020	Dubbo Regional Council Manager of Infrastructure Services		x											Teleconference with DRC infrastructure services team to discuss Twelve Mile Road upgrade design parameters, water sources, and quarries. DRC identified design parameters for the road upgrade (applied in the preliminary design included as an appendix to this EIS) and outlined that DRC would comment as part of review of this EIS. DRC identified that Council's water filling stations were in-principle available to commercial uses (such as construction), however that DRC's quarries were generally for Council projects only.	inform, consult, involve
March 2020	Dubbo Regional Council – Planning & Environment Director		x											Letter sent to confirm the Project's willingness to enter into a Voluntary Planning Agreement for the Project, requesting the opportunity to negotiate further on the terms. Shared the Project's economic benefits analysis (as appendix to this EIS)	inform, consult, involve
April 2020	Residents identified as potential candidates for visual mitigation			x	x									Consultation with residents identified in the visual impact assessment as potentially requiring visual mitigation regarding impacts and potential mitigation measures	inform, consult
April 2020	Residents on Twelve Mile Road access route			x	x									Consultation with residents along the section of Twelve Mile Road to be used as the transport route to inform of the status of the Twelve Mile Road upgrade design process and provide additional detail of potential traffic impacts	inform, consult
April 2020	Residents located on Twelve Mile Road and surrounding local roads				x									Letter to residents located on Twelve Mile Road (Project main access) and surrounding roads to inform of the status of the Twelve Mile Road upgrade design process and provide additional detail of potential traffic impacts	inform, consult
April 2020	Landowners of land adjacent to the Project Site			x										Contact made to inform of the impending Project's EIS submission and the procedural requirement for the DPIE to make contact regarding the application for a State Significant Development on land adjoining their land	inform
April 2020	Minerals Title holders (Endeavour Minerals Pty Ltd, Drummond West Pty Ltd, Syndicate Minerals Pty Ltd, and Monzonite Metals Pty Ltd)			x										Letters sent to titles agents by email advising of the Project and providing maps of Project layout and overlapping Exploration Licences / Exploration Licence Applications.	inform, consult
							Future Consultation								
Early 2020	Wider community (including mailing list subscribers and all residents within 8km)					x	x					x	x	To coincide with the EIS exhibition period in the first half of2020 the project team will distribute newsletters (electronically and hard copy) summarising the key outcomes of the EIS process and the public exhibition process. This will be accompanied with media releases.	inform
Ongoing	Community Consultative Committee Meetings	x												Committee meetings will be ongoing throughout the development process.	inform, consult, involve

Date	Stakeholder	Method											Activity / Outcome	IAP2 spectrum level
		Face to Face Meeting	Phone Call	Email Exchange	Letter (physical)	Newsletter (physical)	Newsletter (electronic)	Public Meeting / Open Day	Survey (physical)	Survey (electronic)	Website Users	Print Media	Radio/TV		
Early 2020	Wider community							X						E-newsletters, mailing lists and direct landowner visits will continue to be used	inform, consult

6.5 Issues Raised During Stakeholder Consultation

During consultation activities described in Section 6.4.3, the Project development team received feedback on a variety of issues listed below. Many have prompted Project design changes in response which are detailed in Section 2.7.

- **Biodiversity loss:** General comments made by stakeholders regarding the biodiversity impacts of the Project. Detailed analysis is contained in Section 8.4;
- **Dust:** Concerns around dust generation mostly along the minor unsealed public roads, as well as the Project construction (although the latter being concerns raised by fewer stakeholders);
- **Erosion:** Issue raised mostly related to roadworks and also the earthworks for the Project on the steep slopes. Detailed analysis contained in Section 8.9.
- **Fire Fighting:** Concerns about WTGs preventing aerial firefighting and positive recognition that the creation of a good quality Project access tracks in a previously minimally accessible area is a positive impact on ground access for firefighting. Detailed analysis contained in Section 8.6.8.
- **Landscape and Visual Amenity:** As part of the Community Consultation process, the Proponent sought feedback from the local community to understand the landscape features and scenic values of the region. The survey was prepared as a simple questionnaire to seek community input. The survey was available for 2 months on the Project website with invitations to participate online sent to over 150 email subscribers. 13 stakeholders responded to the survey and the feedback is discussed in detail in Section 8.2. Hardcopies of the survey were posted to all residents within 8 km of the Project and were also available at the Dubbo Regional Council Customer Service Centre in Wellington.

    - The purpose of the survey was to identify local landscape values and inform the decisions and activities of the Project. The information has been used to inform the wind farm design and the LVIA within this EIS.
    - The survey has been prepared to address requirements of the Visual Assessment Bulletin (DPE, 2016b).
    - There were 15 online and nine hard copies submissions received. Of the 24 responses, there was general support for renewable energy investment in the region, Details of the survey and survey responses (with personal details removed) is available in Appendix R. The most highly valued aspects of the local community were ranked by the community to be farming and views (see Figure 8-1). Local rivers and creeks, farmland and rolling hills,

rocky hills and outcrops were considered to hold the most scenic value. Detailed analysis can be found in Section 8.2.

- **Noise:** Comments on noise relate to operational WTG noise as well as construction noise. Detailed analysis can be found in Section 8.3.
- **Road Modifications, Traffic and Transport Management:** Stakeholder interest regarding the transport routes and road upgrades required to transport the WTGs and other equipment. Other topics raised include the management measures for road use sharing during construction. Detailed analysis can be found in Section 8.5.
- **Water Use**: General community queries regarding the quantity and source of water required for the Project. Detailed analysis can be found in 8.9.

6.6 Summary

The Proponent has worked with the local community since 2011. The project design has changed extensively through consultation with the community over those years. This has included large-scale changes such as the removal of the eastern side of the Project proposed in 2013, through to the micro-scale such as the removal of one or many WTGs to remove impacts from residence(s). Consultation has contributed to a design that satisfies the avoid-minimise-mitigate hierarchy.

7 Environmental Risk Assessment

The Australian New Zealand Risk Management Standard (AS/NZS ISO 31000:2009) defines risk management as the "coordinated activities to direct and control an organisation with regard to risk" (Standards Australia 2009). Risk arises in all aspects of the project life cycle and offers both opportunity and threat and must therefore be managed appropriately. Risk management involves establishing an appropriate risk management culture and applying logical and systematic risk management processes to all stages in the life cycle of any activity, function or operation.

This EIS adopts an environmental impact assessment methodology aligned to the AS/NZS ISO 31000:2009 standard:

- Potential risks (environmental impacts) have been identified through the Environmental Assessment (Section 8);
- Strategies and actions are identified to mitigate the impact of the risk (Section 9);
- An assessment is made of the likelihood of the risk occurring and the consequence if the risk were to occur:
    - the likelihood of the risk occurring is described as very unlikely, unlikely, possible, likely, or almost certain to occur; and
    - the consequences or potential impact if the risk event occurred are described as minor, major, severe, critical or catastrophic.

The risk matrix below (Table 7-1) determines a risk rating of low, medium, high or extreme.

Table 7-1: Environmental risk assessment rating matrix

Risk Assessment Matrix		Consequence				
Likelihood		Minor A	Major B	Severe C	Critical D	Catastrophic E
Very Unlikely	1	Low	Low	Medium	Medium	Medium
Unlikely	2	Low	Low	Medium	Medium	High
Possible	3	Low	Medium	High	High	High
Likely	4	Medium	Medium	High	High	Extreme
Almost Certain	5	Medium	High	High	Extreme	Extreme

An environmental risk analysis has been undertaken for all potential environmental impacts that have been considered within this EIS. The results of this risk analysis are provided in Table 7-2. The unmitigated risk rating is the risk rating prior to detailed assessment, or any mitigation being applied and is therefore precautionary and worst-case.

Table 7-2: Environmental Risk analysis of adverse environmental issues

Factor	Receptor	Potential Impact	Likelihood	Consequence	Unmitigated Risk
Landscape and Visual	Nearby residences	Reduction in visual amenity	4	B	Medium
	Adjoining landscape	Reduction in visual amenity	4	B	Medium
Noise and Vibration	Nearby residences	Nuisance noise levels during construction	4	A	Medium
		Nuisance noise levels during operation	4	B	Medium
Biodiversity	Flora species, plant communities and/or habitat	Disturbance/loss	5	A/B	High
	Fauna species	Injury and mortality	3	B	Medium
	Terrestrial and aquatic ecosystems	Introduction/spread of weeds	3	A	Low
		Introduction/spread of pests	3	A	Low
		Sedimentation and erosion	2	A	Low
		Soil and water pollution	2	A	Low
		Indirect impacts of proposal e.g. light, noise, dust	2	A	Low
Traffic and Transport	Existing road network	Increase in traffic volumes	3	A	Low
		Increased traffic risks and/or reduced safety	3	B	Medium
	Aviation activities	Aviation safety	2	C	Medium

Factor	Receptor	Potential Impact	Likelihood	Consequence	Unmitigated Risk
Hazards / Risk	Telecommunications distributors	Effects on telecommunications systems	2	C	Medium
	Project Site and nearby residences	Health issues relating to electromagnetic fields	2	B	Low
		Health issues relating to low frequency noise and infrasound	2	B	Low
		Health issues relating to shadow flicker and blade glint	2	B	Low
		Use of lithium-ion batteries (ESF)	1	D	Medium
		Bushfire and electrical fire	2	D	Medium
		Blade throw	1	D	Medium
Heritage	Aboriginal heritage	Impacts on known artefacts/values	2	A	Low
		Impacts on unknown artefacts/values	2	B	Low
	Historic heritage	Impacts on known artefacts/values	2	A	Low
		Impacts on unknown artefacts/values	2	B	Low
Water and Soils	Surface water	Degradation of water quality	2	A	Low
	Project Site	Disturbance and erosion of soils and productive topsoil	3	A	Low
		Soil compaction leading to concentrated runoff and erosion	3	A	Low
		Soil contamination due to spills	2	A	Low

Factor	Receptor	Potential Impact	Likelihood	Consequence	Unmitigated Risk
		Introduction/spread of weeds	3	A	Low
	Nearby properties	Reduced agricultural viability	2	B	Low
		Dust deposition	2	A	Low
		Reduction in water quantity	1	A	Low
		Flooding	1	A	Low
	Groundwater	Degradation of water quality	1	A	Low
		Reduction in water quantity	1	A	Low
	Aquatic Ecosystems	Direct Impacts	2	A	Low
		Indirect Impacts	2	A	Low
Waste	Project site and adjoining areas	Contamination of land and water	1	A	Low
		Resource wastage	2	A	Low
		Human and environmental health	2	B	Low
Social and Economic	Social	Safety	2	D	Medium
		Health	2	A	Low
		Water Consumption	3	A	Low
	Economic	Decreased Land Value	1	B	Low

In summary, the following environmental risks were considered to be key issues for detailed technical assessment (Section 8) and consideration of mitigation strategies (Section 9) within this EIS:

- Landscape and Visual;
- Noise and Vibration;
- Biodiversity;
- Traffic and Transport; and
- Hazards and Risks.

8 Environmental Impact Assessment

8.1 Assessment methodology

The **Environmental Assessment** (this section) has been undertaken to assess potential environmental impacts for a range of specific issues identified within the SEARs and through site investigations. These are:

Issues	Section
Landscape and Visual	8.2
Noise and Vibration	8.3
Biodiversity	8.4
Traffic and Transport	8.5
Hazards / Risks	8.6
Heritage	8.7
Water and Soils	8.9
Waste	8.10
Socio-Economic Factors	8.11

A description of ***existing conditions*** is provided for each issue, considering existing levels of development, as well as antecedent conditions as relevant. This provides an opportunity to consider both environmental state and function in the absence of the Proposed Development.

In accordance with the requirements of the SEARs, all ***potential impacts*** associated with the Proposed Development are considered across the entire lifespan of the development, considering construction, operational and decommissioning phases. Potential impacts are considered in addition to existing environmental conditions, representing potential cumulative impacts. Furthermore, where known future development is proposed, consideration is given to potential cumulative impacts as relevant.

Mitigation measures are proposed to effectively manage all potential environmental impacts. These may include design considerations, monitoring strategies, construction safeguards, consultation, training and awareness programs, modified work practices, management plans or other relevant management strategies. A full list of mitigation and environmental management strategies and commitments is provided in **Environmental Management** (Section 9).

The **Project Justification** (Section 3) provided triple-bottom-line (environmental/social/economic) evaluation of the Proposed Development in order to fully describe potential benefits and impacts to the environment and the local, regional and NSW community.

Potential **residual environmental risks** following mitigation are investigated using likelihood/consequence analysis to describe the potential magnitude of residual impacts. Where the mitigated impact remains high or extreme, further justification is provided to contextualise project risks going forward.

Justification against high level social and economic expectations is then considered against the principles of **ESD**, and more specifically, considering the **socio-economic** attributes associated with the Proposed Development.

Finally, **potential alternatives** are considered to ensure that approval of the Proposed Development is not detrimental when assessed against potential alternative land uses or development.

The **Conclusion** (Section 10) integrates the relevant **Statutory and Planning Framework** (Section 5) and commitments made through the **Stakeholder and Community Consultation** process (Section 6with the findings of the **Environmental Assessment** to provide a concise statement regarding the suitability of the Proposed Development and outlines any key points for consideration as part of the development approval process.

8.2 Landscape and Visual

The Project is located in a gently undulating landscape dominated by agricultural grazing activities. Through on going consultation during the Project's evolution, the project has sought to minimise impacts to nearby receptors and to identify alternative design approaches to achieve improved outcomes, such as reducing the number and relocating WTGs, while maintaining power generation capacity through larger WTG's.

The validity of this process is demonstrated in Table 8-1 and Table 8-2 below. By increasing the size and decreasing the number of WTGs, the number of local residences (within approximately 12 km of the Project) from which WTGs would be visible has been significantly decreased without jeopardising the feasibility of the project (Table 8-1).

Table 8-1: Residence impact minimisation changes over time – Residences with WTGs visible

	2013 249 WTG layout and 200m BTH	2018 127 WTG layout and 200m BTH	2018 125 WTG layout and 250m BTH	2019 117 WTG layout and 250m BTH	2019 109 WTG layout and 250m BTH	2020 97 WTG layout and 250m BTH
Number of Residences	191	92	95	88	89	84

Furthermore, since adopting the larger WTG design with a maximum BTH of 250 m in 2018, further design evolution has successfully mitigated the magnitude of impacts at many residences (Table 8-2). At the time of preparation, potential impacts at eight residences may require further mitigation prior to detailed design and micrositing.

Table 8-2: Residence impact minimisation changes over time – Non-associated residences requiring visual impact mitigation

	2018 125 WTG layout and 250m BTH	2019 117 WTG layout and 250m BTH	2019 109 WTG layout and 250m BTH	2020 97 WTG layout and 250m BTH
Number of Residences	20	N/A	16	11

8.2.1 Introduction

The LVIA has been prepared by Moir Landscape Architecture Pty Ltd (Moir Landscape Architecture, 2020), and has been undertaken in accordance with the requirements of the SEARs, which include:

> *A detailed assessment of the likely visual impacts of all components of the project (including turbines, transmission lines, substations, and any other ancillary infrastructure) in accordance with the Wind Energy: Visual Assessment Bulletin (DPE, 2016b).*

A full copy of the LVIA is provided in Appendix R. This section provides a summary of the existing environment, methods, results and discussion of the LVIA and steps to be taken to mitigate potential impacts to nearby sensitive receptors and the environment.

The purpose of the LVIA is to identify and describe the existing landscape character and identify both private and public visual amenity receptors and, as a consequence of the introduction of the Project, to assess potential visual impacts.

In accordance with the Visual Assessment Bulletin (DPE, 2016b), the LVIA included:

- A baseline study, which included an analysis of the landscape character, scenic quality and visibility from viewpoints of different sensitivity levels;
- The establishment of visual influences zones from viewpoints using data collected in the baseline study;
- An assessment of the proposed layout against visual performance objectives; and
- A justification for the final proposed layout and identification of mitigation and management measures.

Key visual components associated with the Project include:

- Up to 97 WTGs, which will be up to 250 m from the ground to upper blade tip;
- One ESF;
- Substations;
- Two O&M compounds;
- 90 km of Internal Roads;
- 12 km of external overhead cables;
- 15 km of internal overhead cables;
- 6 permanent meteorological masts; and
- 90 km of underground transmission lines.

Detailed mitigation and management measures are provided in Appendix R, and are summarised in Environmental Management (Section 9) as Statement of Commitments LV001, LV002 and LV003.

8.2.2 Existing Environment

8.2.2.1 Landscape Character of the Region

The Project is located approximately 17 km south-south east of Goolma, NSW, within the Upper Slopes subregion of the South Western Slopes bioregion. The landscape is generally gently undulating to undulating and is dominated by agricultural activities. Lake Burrendong, which drains into the Macquarie River, is located south of the Project. An elevated ridge line, associated with the Mount Arthur Reserve, is located to the west of Wellington. Burrendong State recreation area surrounds Lake Burrendong with elevated ridges to the south.

The character of the landscape has shifted considerably over time due to European settlement. The Project Site was once dominated by open forest and woodland, which has now been extensively cleared for agricultural use. Gentle slopes have been cleared to increase grazing areas, however, areas with steeper, rugged ridges and ranges or areas close to creek lines, along roadsides and property boundaries remain vegetated.

Lake Burrendong, which was created with the construction of Burrendong Dam on the Macquarie River, is the most prominent water body of the region. The Macquarie River and associated tributaries form the drainage system of the region. Cudgegong River, a main tributary of the Macquarie River, runs east of the Project with a number of smaller tributaries of Cudgegong River running through the landscape.

8.2.2.2 Landscape Values

A Community Survey of Landscape Values was undertaken by Moir Landscape Architecture (2020) to assist in identifying key landscape values. Of the 24 responses, the most highly valued aspect of the local community was farming (32%) and views (26%) (Figure 8-1). Local rivers and creeks, farmland and rolling hills, rocky hills and outcrops were considered to hold the most scenic value.

There was general support for renewable energy investment in the region however, 77% of those surveyed believed there would be a negative impact on the character of the local landscape (Figure 8-1).

8.2.2.3 Scenic Quality Class Ratings

The Project has a similar landscape character throughout, however, subtle variations in the landscapes geology, topography, land use and vegetation have been identified. The landscape has therefore been classified into seven distinct units of landscape character (Table 8-3;Figure 8-2). To assist in defining the Visual Influence Zones, each Landscape Character Unit (LCU) was also assigned a scenic quality rating of low, moderate or high, in accordance with the Visual Assessment Bulletin (DPE, 2016b).

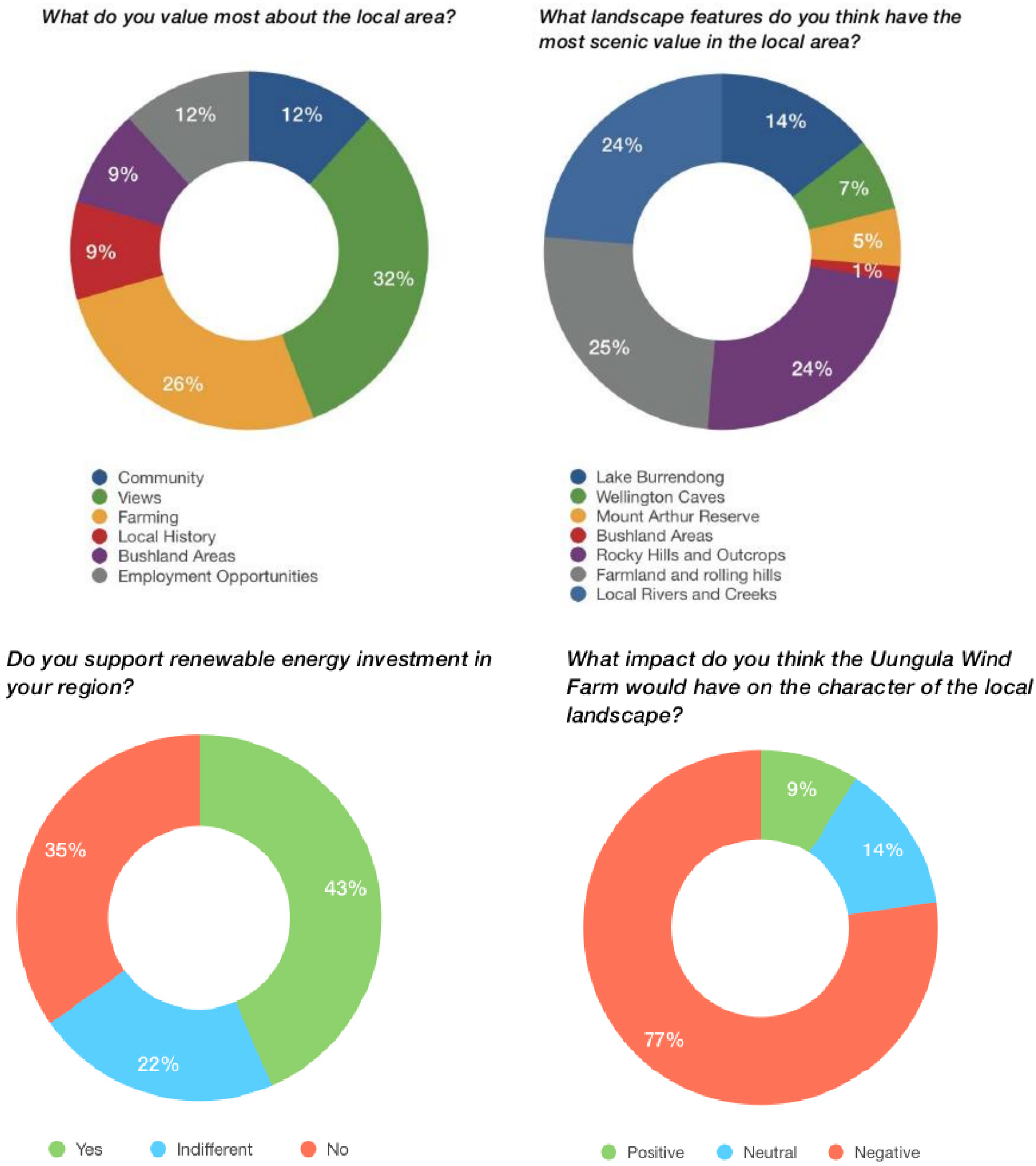


Figure 8-1: Results of Community Survey of Landscape Values (Moir Landscape Architecture, 2020)

Table 8-3: Description of Landscape Character Units and Scenic Quality Class Ratings

Landscape Character Unit	Description	Scenic Quality Class
Wellington	This LCU is defined by the generally undulating land to the east of Wellington and is bounded to the north by Goolma Road, to the south by the Macquarie River and to the east by Poggy Creek. The landscape is generally cleared for agricultural practices except for remnant vegetation associated with hilltops, drainage lines and homesteads. Views are generally contained by local rises and vegetation and are viewed against the vegetated Dickerton Ridge.	Low
Bodangora	This LCU is defined by the generally flat land to the south of Mount Bondangora and includes land generally associated with Mitchell Creek between Goolma Road and to the south of Twelve Mile Road. Land within this LCU is predominantly cleared for grazing purposes with some riparian vegetation associated with the creek line and sloped areas. Views are generally expansive due to the flat landform.	Low
Spicers Creek	This LCU is defined by the undulating land to the south west of Goolma and is bounded to the north by Goolma Road, to the south by Twelve Mile Road and to the east by the valley associated with the Cudgegong River. Land within this LCU is undulating, utilised for agricultural practices, with some remnant vegetation scattered through the landscape. This LCU also consists of minor creek and drainage lines and associated riparian vegetation. Views within this LCU are generally contained by topography.	Moderate
Wuuluman	This LCU is defined by the land associated with Dickerton Ridge, Yarragul Ridge and their foothills and is bounded to the south by the Macquarie River and Lake Burrendong, to the east by Poggy Creek and to the west by Ilgingery Creek. Dickerton Ridge and Yarragul Ridge are steep vegetated ridges, which are visible from a large percentage of the site, creating a valley and containing views along Wuuluman Road.	Moderate
Uungula	This LCU is characterised by the generally uninhabited undulating land to the north of Lake Burrendong and is bounded to the west by Ilgingery Road, to the south by Lake Burrendong and to the east by the valley associated with the Cudgegong River. Land in this LCU is predominantly utilised for grazing and as a result is mostly cleared with the exception of some scattered vegetation.	Moderate

Burrendong	This LCU is defined by Lake Burrendong, associated State Recreation Areas and vegetated ranges to the south of the Cudgegong River and is bounded by Tara Road to the south west and vegetated ridges visible from Lake Burrendong to the east. Lake Burrendong is valued for its attractive setting with expansive views over the lake towards vegetated ranges. The LCU was assessed giving consideration to the fact that water level can change in Lake Burrendong.	Moderate
Cudgegong	This LCU includes the generally uninhabited land to the north of Lake Burrendong associated with the Cudgegong River. Views are generally contained by undulating topography either side of the valley floor.	Moderate

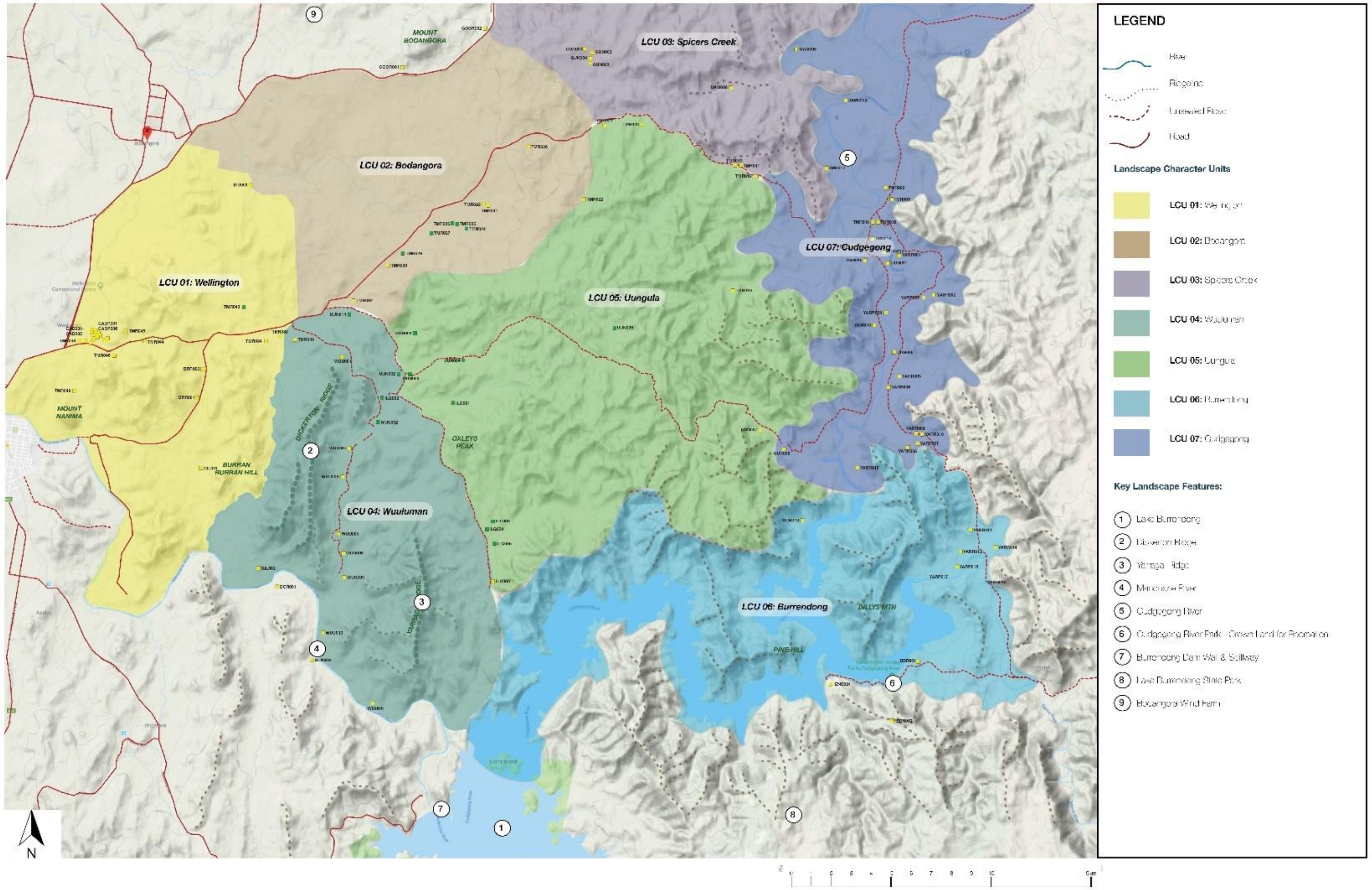


Figure 8-2: Visual baseline and character units map (Moir Landscape Architecture, 2020)

8.2.3 Potential Impacts

8.2.3.1 Zone of Visual Influence

An assessment of Zone of Visual Influence (ZVI) was undertaken by Moir Landscape Architecture (2020) to identify the areas of surrounding land from which the Project may be partially or completely visible. As a worst-case scenario, the ZVI assessment was based on the blade tip of each WTG (being 250 m). The ZVI assessment was determined using topographic information and 3D modelling software and was solely based on topographic information due to a lack of accurate information on the height and coverage of vegetation and buildings. For this reason, the zone of visibility of the Project will be considerably less than the worst-case scenario which has been assessed.

Out of the 111 assessed dwellings, it was concluded that there are six dwellings within 3.35 km of the nearest WTG where mitigation measures are recommended (depicted in red in Table 8-4 and shown in Figure 8-3). These include dwellings TMR022, TMR023, TMR031, WUU005, WUU007, and TMR016. There are a further four dwellings within 3.35 – 5.0 km of the nearest WTG where screening may be required (depicted in orange in Table 8-4). These include dwellings TMR036, WUU001, WUU009 and UUN008.

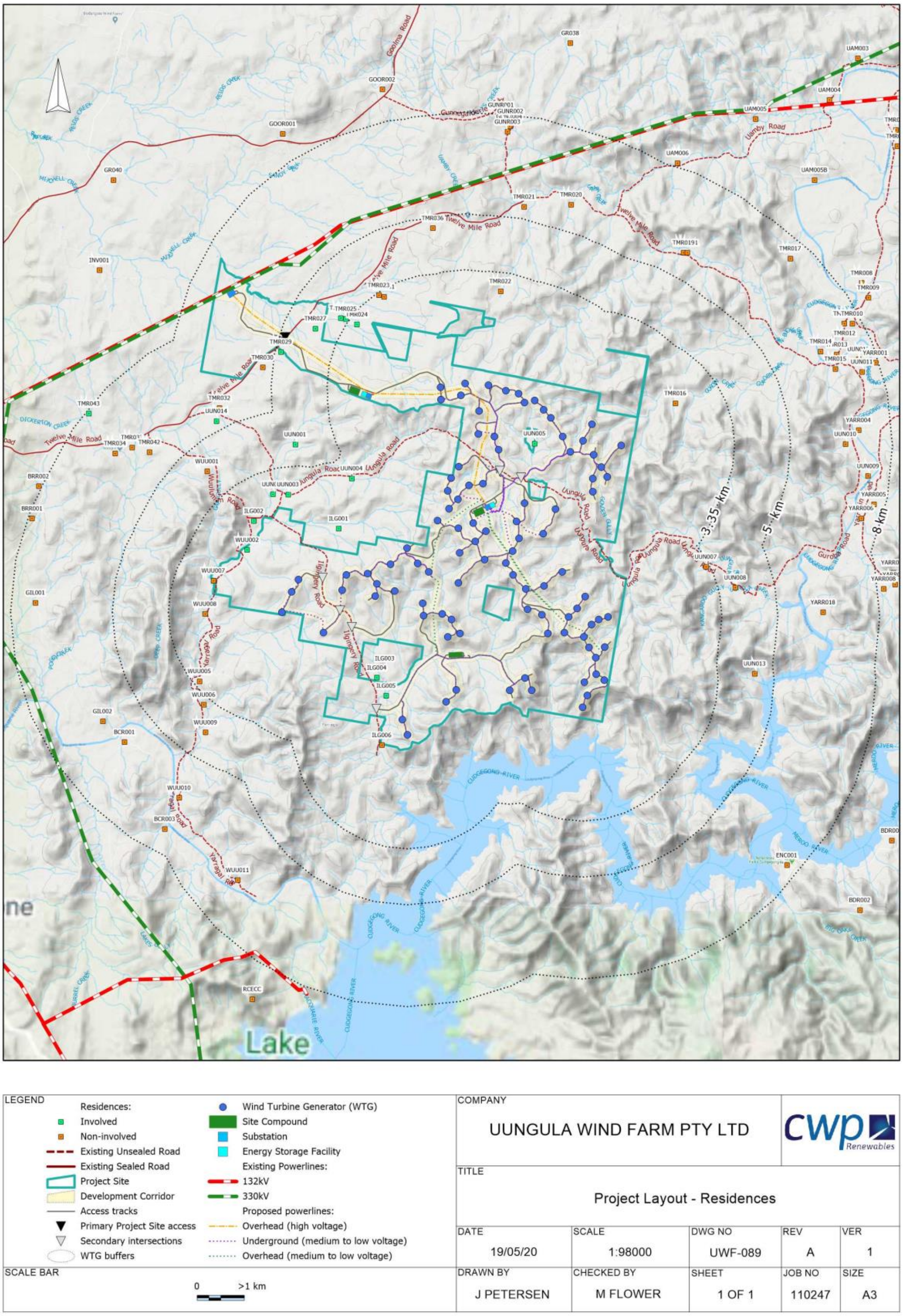


Figure 8-3: Residences within and surrounding the Project Site

Table 8-4: Summary of ZVI Assessment for each dwelling (Moir Landscape Architecture, 2020)

LCU	Dwelling ID	Distance to Nearest WTG (km)	Level of Impact (No[4]/Potential[5])	Mitigation Required (Y/N)	Screen to be Considered (Y/N)	Reasoning
Wellington	BRR001	7.85	No	No	No	No visibility due to topography.
	BRR002	8.07	No	No	No	No visibility due to topography.
	CAD001-005	11.57 – 12.09	No	No	No	No visibility due to topography.
	CAD001-006	11.89 – 12.18	No	No	No	No visibility due to topography.
	GIL001	7.26	No	No	No	No visibility due to topography.
	GIL002	6.18	No	No	No	No visibility due to topography.
	INV001	10.60	Potential	No	No	Vegetation surrounding property likely to screen potential views.
	TMR033	6.26	Potential	No	No	Vegetation surrounding property likely to screen potential views.
	TMR034	6.56	Potential	No	No	Vegetation surrounding property likely to screen potential views.
	TMR042	7.87	Potential	No	No	Vegetation surrounding property likely to screen potential views.

[4] The Project will not be visible due to topography

[5] The Project may be visible based on topography alone

LCU	Dwelling ID	Distance to Nearest WTG (km)	Level of Impact (No[4]/Potential[5])	Mitigation Required (Y/N)	Screen to be Considered (Y/N)	Reasoning
	TMR043	7.87	Potential	No	No	Involved residence.
	TMR044	10.33	No	No	No	No visibility due to topography.
	TMR045	11.12	No	No	No	No visibility due to topography.
	TMR046	11.13	No	No	No	No visibility due to topography.
	TMR047	12.26	No	No	No	No visibility due to topography.
	TMR048	12.44	No	No	No	No visibility due to topography.
	TMR049	12.08	No	No	No	No visibility due to topography.
Bodangora	GOOR001	8.73	Potential	No	No	Vegetation surrounding property likely to screen potential views.
	GOOR002	8.87	Potential	No	No	Vegetation surrounding property likely to screen potential views.
	TMR022	2.78	Potential	Yes	No	Non-involved residence within 3.35 km of the nearest WTG. Approximately 30 WTGs likely to be visible. Scattered vegetation may fragment views.
	TMR023	3.20	Potential	Yes	No	Non-involved residence within 3.35 km of nearest WTG. Approximately 30 WTGs likely to be visible. Vegetation may screen the majority of views.
	TMR024	3.03	Potential	No	No	Involved residence.
	TMR025	3.40	Potential	No	No	Involved residence.
	TMR026	3.54	Potential	No	No	Involved residence.

LCU	Dwelling ID	Distance to Nearest WTG (km)	Level of Impact (No[4]/Potential[5])	Mitigation Required (Y/N)	Screen to be Considered (Y/N)	Reasoning
	TMR027	4.04	Potential	No	No	Involved residence.
	TMR029	4.80	Potential	No	No	Involved residence.
	TMR030	5.26	Potential	No	No	Vegetation surrounding property likely to screen potential views.
	TMR031	3.08	Potential	Yes	No	Non-involved residence within 3.35 km of the nearest WTG. Based on topography alone, approximately 30 WTGs will be visible to the south east. However, vegetation in the foreground would significantly reduce potential views to the Project with approximately five WTGs visible through gaps in vegetation.
	TMR032	5.56	Potential	No	No	Vegetation surrounding property likely to fragment potential views.
	TMR036	4.62	Potential	Consider	Yes	Non-involved residence within 3.35 km – 5 km of the nearest WTG. Approximately 15 WTGs may be visible beyond the rise in topography. Vegetation may reduce the number of visible WTGs.
Spicers Creek	GUNR001	7.95	Potential	No	No	Vegetation surrounding property likely to screen potential views.
	GUNR002	7.79	Potential	No	No	Vegetation and farm buildings likely to obstruct potential views.
	GUNR003	7.47	Potential	No	No	Vegetation surrounding property likely to screen potential views.

LCU	Dwelling ID	Distance to Nearest WTG (km)	Level of Impact (No[4]/Potential[5])	Mitigation Required (Y/N)	Screen to be Considered (Y/N)	Reasoning
	GUNR004	7.62	Potential	No	No	Vegetation surrounding property likely to fragment potential views.
	TMR018	5.59	No	No	No	No visibility due to topography.
	TMR019	5.59	Potential	No	No	Vegetation surrounding property likely to screen potential views.
	TMR020	5.77	Potential	No	No	Vegetation and farm buildings surrounding property likely to screen potential views.
	TMR021	5.35	Potential	No	No	Vegetation and farm buildings surrounding property likely to screen potential views.
	TMR041	5.77	No	No	No	No visibility due to topography.
	UAM005	10.20	Potential	No	No	Views to approximately 10 WTGs may be available in the distance to the south.
	UAM006	8.08	No	No	No	No visibility due to topography.
Wuuluman	BCR001	6.01	No	No	No	No visibility due to topography.
	BCR002	7.26	Potential	No	No	Vegetation surrounding property likely to screen potential views.
	ILG002	2.16	Potential	No	No	Involved landowner.
	WUU001	4.17	Potential	Consider	Yes	Non-involved residence within 3.35 km – 5 km of the nearest WTG. Up to 90 WTGs likely to be visible due to the elevated position of this residence.

LCU	Dwelling ID	Distance to Nearest WTG (km)	Level of Impact (No[4]/Potential[5])	Mitigation Required (Y/N)	Screen to be Considered (Y/N)	Reasoning
	WUU002	1.74	Potential	No	No	Involved landowner.
	WUU005	3.17	Potential	Yes	No	Non-involved residence within 3.35 km of the nearest WTG. Up to 25 WTGs may be visible to the north east. Vegetation and sheds may obstruct views.
	WUU006	3.57	Potential	No	No	Non-involved residence within 3.35 km – 5 km of the nearest WTG. Based on the distance to the nearest WTG and topography alone, the tips of three WTGs would be visible to the north east. Further assessment identified that existing vegetation would screen views therefore, no further mitigation will be required.
	WUU007	2.22	Potential	Yes	No	Non-involved residence within 3.35 km of the nearest WTG. The blades of four WTGs are likely to be visible beyond the rise to the east, a further nine WTGs may be visible to the north east in the distance. Vegetation and sheds may obstruct views.
	WUU008	2.26	Potential	No	No	Non-involved residence within 3.35 km of the nearest WTG. Based on the distance to the nearest WTG and topography alone, three WTGs are likely to be visible on the hill to the east. The blades of up to six WTGs may also be visible in the distance. Further assessment identified that existing vegetation would screen views therefore, no further mitigation is required.

LCU	Dwelling ID	Distance to Nearest WTG (km)	Level of Impact (No[4]/Potential[5])	Mitigation Required (Y/N)	Screen to be Considered (Y/N)	Reasoning
	WUU009	4.19	Potential	Consider	Yes	Non-involved residence within 3.35 km – 5 km of the nearest WTG. Blades of up to ten WTGs are likely to be visible to the north east. Existing vegetation surrounding the property may fragment views.
	WUU010	6.25	No	No	No	No visibility due to topography.
	WUU011	6.57	No	No	No	No visibility due to topography.
	UUN003	2.52	Potential	No	No	Involved landowner.
	UUN004	2.62	Potential	No	No	Involved landowner.
	UUN005	0.82	Potential	No	No	Involved landowner.
	UUN007	2.73	Potential	No	No	Non-involved residence within 3.35 km of the nearest WTG. Based on topography alone, approximately 12 WTGs visible to the north west. Existing vegetation in aerial imagery is likely to sufficiently screen views therefore, no further mitigation will be required.
Uungula	UUN008	2.46	Potential	Consider	Yes	Non-involved residence within 3.35 km – 5 km of the nearest WTG. 12 WTGs visible to the north west, in excess of 4 km from residence. Vegetation associated with the Cudgegong River is likely to screen the majority of views.
	UUN013	4.4	No	No	No	No visibility due to topography.
	ILG001	1.38	Potential	No	No	Involved landowner.

LCU	Dwelling ID	Distance to Nearest WTG (km)	Level of Impact (No[4]/Potential[5])	Mitigation Required (Y/N)	Screen to be Considered (Y/N)	Reasoning
	ILG003	1.59	Potential	No	No	Involved landowner.
	ILG004	1.44	Potential	No	No	Involved landowner.
	ILG005	0.84	Potential	No	No	Involved landowner.
	ILG006	0.80	Potential	No	No	Non-involved residence within 3.35 km of the nearest WTG. Based on topography alone, up to 50 WTGs will be visible however, this is a derelict house therefore no mitigation is required.
	TMR016	2.0	Potential	Yes	No	Non-involved residence within 3.35 km of the nearest WTG. Based on topography alone, 14 WTGs and 6 WTG blade tips are likely to be visible to the east. Existing vegetation may fragment views.
Burrendong	BDR001	6.88	No	No	No	No visibility due to topography.
	BDR002	7.87	Potential	No	No	Vegetation surrounding property likely to screen potential views.
	ENC001	5.74	Potential	No	No	Cabins associated with Cudgegong River Park likely to obstruct views.
	YARR012	6.68	No	No	No	No visibility due to topography.
	YARR013	6.63	No	No	No	No visibility due to topography.
	YARR014	7.90	No	No	No	No visibility due to topography.
	YARR016	7.71	No	No	No	No visibility due to topography.

LCU	Dwelling ID	Distance to Nearest WTG (km)	Level of Impact (No[4]/Potential[5])	Mitigation Required (Y/N)	Screen to be Considered (Y/N)	Reasoning
	YARR017	5.66	No	No	No	No visibility due to topography.
Cudgegong	UAM005B	9.67	Potential	No	No	Vegetation to the south likely to screen views.
	UUN009	7.27	No	No	No	Planting associated with the property likely to screen views.
	UUN010	6.61	No	No	No	No visibility due to topography.
	UUN011	7.42	No	No	No	No visibility due to topography.
	UUN012	7.44	Potential	No	No	Vegetation in the foreground to the west likely to fragment views.
	TMR008	8.55	Potential	No	No	Up to 50 WTGs would be visible on the distant ridgeline to the west.
	TMR009	8.49	Potential	No	No	Approximately 50 WTGs would be visible on the distant ridgeline to the south west.
	TMR010	7.69	Potential	No	No	Up to 25 WTGs would be visible on the distant ridgeline to the west.
	TMR011	7.49	Potential	No	No	Vegetation surrounding the property likely to screen views.
	TMR012	7.24	Potential	No	No	Vegetation to the west likely to screen views.
	TMR013	6.89	Potential	No	No	Vegetation to the west likely to screen views.
	TMR014	6.50	Potential	No	No	Vegetation associated with Cudgegong River likely to fragment views.
	TMR015	6.71	Potential	No	No	Vegetation likely to screen views.
	TMR017	7.42	No	No	No	No visibility due to topography.

LCU	Dwelling ID	Distance to Nearest WTG (km)	Level of Impact (No[4]/Potential[5])	Mitigation Required (Y/N)	Screen to be Considered (Y/N)	Reasoning
	YARR001	7.88	Potential	No	No	Several blade tips are likely to be visible in the distance beyond the ridge to the south.
	YARR002	8.79	Potential	No	No	Vegetation likely to screen views.
	YARR003	8.39	Potential	No	No	Up to 20 WTGs are visible (based on topography alone) in the distance (in excess of 9 km) to the south west from this residence.
	YARR004	7.01	No	No	No	No visibility due to topography.
	YARR005	7.70	Potential	No	No	Sheds and vegetation likely to screen views.
	YARR006	7.40	Potential	No	No	Sheds and vegetation likely to screen views.
	YARR007	8.50	Potential	No	No	Views to approximately 40 WTGs would be visible on the distant ridge to the west.
	YARR008	8.20	Potential	No	No	Views of up to 15 WTGs would be available on the distant ridge to the west.
	YARR009	8.50	Potential	No	No	Vegetation likely to fragment views.
	YARR010	8.70	Potential	No	No	Sheds and vegetation likely to screen views.
	YARR018	6.30	Potential	No	No	Elevated residence with expansive views across to ridge to the east. Approximately 50 WTGs would be visible on the ridgeline to the east of this residence.

8.2.3.2 Viewpoint Analysis

A viewpoint analysis was undertaken to determine the likely impact the Project would have on the existing landscape character and visual amenity. A total of 46 viewpoints were assessed (Figure 8-4), which were selected to illustrate a combination of the following:

- Present landscape character types;
- Areas of high landscape or scenic value;
- Visual composition (e.g. focused or panoramic views, simply or complex landscape pattern);
- Range of distances;
- Varying aspects and elevations;
- Varying extent of wind farm visibility (full and partial visibility); and
- Sequential views along specific routes.

Potential visual impacts at each viewpoint are summarised in Table 8-5. An evaluation of each viewpoint was undertaken using the corresponding Visual Performance Objectives, as outlined within Table 2 of the Visual Assessment Bulletin (DPE, 2016b).

Visual Influence Zone One (VIZ1)

The assessment identified three viewpoints located within VIZ1, which may be visually impacted by the Project, being VP32, VP33 and VP35. VP33 and VP35. Mitigations would need to be considered for all residences associated with these viewpoints and are recommended per dwelling in Table 8-4.

Visual Influence Zone Two (VIZ2)

The Viewpoint Analysis concluded that the Project was likely to dominate existing views from six viewpoints within the VIZ2, being VP28, VP29, VP31, VP34 and VP46. Mitigations would need to be considered for some residences associated with these viewpoints and are recommended per dwelling inTable 8-4.

Visual Influence Zone 3 (VIZ3)

Thirteen viewpoints were classified within VIZ3. No visual performance objective applies for landscape scenic integrity or key feature disruption.

The viewpoint analysis found that due to undulating topography of the Site there are very limited opportunities to view the Project in its entirety. One exception is the viewpoint recorded from a residence on Wuuluman Road (WUU001) associated with VP46, where due to the elevated position of the residence and lack of screening factors, views towards the Project are unimpeded.

Table 8-5: Viewpoint analysis results (Moir Landscape Architecture, 2020)

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP01	3	View from Twelve Mile Road approximately 500 m east of Goolma Road.	No visibility due to topography.	Not applicable.
VP02	3	View from 'Brookfield Road', a small farm road off Twelve Mile Road which provides access to a small number of isolated homesteads.	No visibility due to topography.	Not applicable.
VP03	3	Viewpoint from Gilgoan Road approximately 500 m north east of dwelling GIL001.	Views likely to be screened by Dickerton Ridge to the east.	Not applicable.
VP04	3	Viewpoint from Twelve Mile Road approximately 260 m north of the entry to dwelling TMR034.	Up to 30 WTGs are likely to be visible beyond the hills in the background to the east. Vegetation likely to assist in fragmenting views to motorists travelling along Twelve Mile Road. Vegetation surrounding dwellings likely to screen and / or fragment views.	Not applicable.
VP05	3	View from Twelve Mile Road adjacent to dwelling TMR032.	Up to 20 WTGs are likely to be visible (based on topography alone) beyond the hills in the middle ground. Existing scattered vegetation likely to obstruct views in some locations.	Not applicable.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP06	3	Viewpoint from Twelve Mile Road approximately 130 m north east of the entry to dwelling TMR029.	Up to 20 WTGs would be visible to the east. Approximately half of the WTGs visible from this viewpoint would be blade tips only. Vegetation in the middle ground is likely to fragment views.	Not applicable.
VP07	3	View from the entry to dwellings TMR024, TMR025, TMR026 and TMR027 on Twelve Mile Road looking in a generally south east direction towards the Project.	Approximately 22 WTGs would be visible the south east. Views towards this direction are largely screened by vegetation.	Not applicable.
VP08	3	View from Twelve Mile Road at the entry to dwelling TMR036.	Up to 20 WTGs are likely to be visible based on topography alone. Vegetation in the foreground is likely to screen views to the proposed WTGs from this location.	Not applicable.
VP09	3	Viewpoint from Goolma Road located approximately 670 m to the east of the entry to dwelling GOOR001.	Over 50 WTGs are likely to be visible beyond the ridgeline in the distance. Vegetation in the middle ground may assist in partially screening views to the Project.	Not applicable.
VP10	2	View from Gunnegalderie Road, approximately 3.5 km east of Goolma Road.	Up to 70 WTGs are likely to be visible on the ridgeline in the distance. Vegetation in the middle ground is likely to reduce the number of WTGs visible from this location.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
				Landscape Scenic Integrity: The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any visual impact on key landscape features from this location.
VP11	2	Viewpoint from Gunnegalderie Road approximately 4.3 km east of Goolma Road.	70 WTGs associated with the Project will be visible to the south from this viewpoint. Views likely to be screened by vegetation associated with Cudgegong River in the foreground.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have a major visual impact on key landscape features from this location.
VP12	2	View from Twelve Mile Road approximately 1.7 km to the east of the Gunnegalderie Road intersection.	Approximately 12 WTGs will be visible beyond the ridgeline in the middle ground.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
				Key Feature Disruption: The Project is unlikely to have any visual impact on key landscape features from this location.
VP13	3	Viewpoint from Uamby Road, adjacent to dwelling UAM006.	The proposed WTGs will not be visible from this viewpoint due to topography.	The proposed WTGs will not be visible from this viewpoint.
VP14	3	Viewpoint recorded from unsealed road off Uamby Road, approximately 630 m west of dwelling UAM005B.	The proposed WTGs will not be visible from this viewpoint due to topography.	The proposed WTGs will not be visible from this viewpoint.
VP15	2	View from Twelve Mile Road along the valley floor to the north of the Project.	The proposed WTGs will not be visible from this viewpoint due to topography and vegetation.	The proposed WTGs will not be visible from this viewpoint.
VP16	2	View from Twelve Mile Road near dwelling TMR018.	The proposed WTGs will not be visible from this viewpoint due to topography and vegetation.	The proposed WTGs will not be visible from this viewpoint.
VP17	2	View from Yarrabin Road, approximately 350 m south of the intersection with Twelve Mile Road.	Approximately 30 WTGs are likely to be visible on the ridgeline in the background. Existing vegetation associated with dwelling TMR010 is likely to fragment views to some WTGs from this location.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
				Key Feature Disruption: The Project is unlikely to have any visual impact on key landscape features from this location.
VP18	3	View from Yarrabin Road adjacent to dwelling YARR002.	Up to five WTGs may be visible to the south west, however they are likely to be fragmented by a combination of topography and vegetation associated with Cudgegong River.	Not applicable.
VP19	2	View from Yarrabin Road, looking west along the entry towards dwelling YARR004.	The proposed WTGs will not be visible from this viewpoint due to topography.	The proposed WTGs will not be visible from this viewpoint.
VP20	2	View from Yarrabin Road, approximately 130 m south of the entry to both dwellings YARR005 and YARR006.	The tips of approximately eight WTGs are likely to be visible on or beyond the vegetated ridgeline in the background.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any visual impact on key landscape features from this location.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP21	2	View from Yarrabin Road, approximately 80 m east of the entry to dwelling YARR009.	Up to 40 WTGs likely to be visible on and beyond the ridgeline in the distance.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any major visual impact on key landscape features from this location.
VP22	2	View from Yarrabin Road, at the entry to dwelling YARR013.	The proposed WTGs will not be visible from this viewpoint due to topography.	The proposed WTGs will not be visible from this viewpoint.
VP23	2	View from Wuuluman Road, at the entry to dwelling WUU011.	The proposed WTGs will not be visible from this viewpoint due to topography.	The proposed WTGs will not be visible from this viewpoint.
VP24	2	View from Wuuluman Road looking in a generally north east direction towards the Project.	Approximately four WTGs will be visible on the ridge beyond dwelling WUU006. Vegetation will assist in screening views to these WTGs.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any major visual impact on key landscape features from this location.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP25	2	Viewpoint from Wuuluman Road, dwelling WUU005.	Approximately 25 WTGs will be visible on the ridge to the north east. Vegetation likely to assist in screening views.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any major visual impact on key landscape features from this location.
VP26	2	View from Wuuluman Road approximately 60 m south west of the entry to dwelling WUU007.	Approximately 16 WTGs are likely to be visible on the distant ridge to the north east. The blades of a further three WTGs are likely to be visible approximately 2km from this viewpoint beyond the rise in the foreground.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any major visual impact on key landscape features from this location.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP27	2	Viewpoint from Wuuluman Road, near dwelling WUU002.	Approximately 50 WTGs are likely to be visible on the ridge to the north east. It is likely vegetation will assist in screening views.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any major visual impact on key landscape features from this location.
VP28	2	Viewpoint from the top of Wuuluman Road, near dwelling ILG002, looking over undulating grazing land toward the east.	Approximately 70 WTGs will be visible on the ridge to the east. It is likely vegetation will assist in fragmenting views.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project likely to modify the visual catchment from this location. **Key Feature Disruption:** The Project would be visible on the vegetated ridge, altering the visual character from this location.
VP29	2	Viewpoint from Wuuluman Road, dwelling near WUU001	Approximately 50 WTGs are likely to be visible on the vegetated ridge in the distance to the east.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
				Landscape Scenic Integrity: The Project is likely to modify however, will not dominate, the existing visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any major visual impact on key landscape features from this location.
VP30	3	Viewpoint was recorded from Uungula Road approximately 3 km south east of the Twelve Mile Road intersection.	Approximately 50 WTGs are likely to be visible on the ridge to the east. Scattered remnant vegetation in the foreground and along the ridgeline would fragment views.	Not applicable.
VP31	2	Viewpoint from Uungula Road, adjacent to dwellings UUN002 and UUN003.	Up to 50 WTGs will be visible on the ridge from the north east to south east. Vegetation surrounding dwelling UUN003 will assist in fragmenting views.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is likely to be visible however, will not dominate the existing visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any major visual impact on key landscape features from this location.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP32	1	View from Ilgingery Road at the entry to dwelling ILG001.	Up to 40 WTGs are likely to be visible at varying distances. The nearest WTGs are located to the south and are likely to become a noticeable element in the visual landscape from this location.	**Visual Magnitude:** Mitigation methods are required for nearby residences. **Landscape Scenic Integrity:** The Project has the potential to form a dominant element in the visual landscape however, unlikely to completely modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any major visual impact on key landscape features from this location.
VP33	1	View from Ilgingery Road looking in a generally north direction.	Up to 70 WTGs are likely to be visible from this location from the north west to the south east at varying distances. The highest visual impact is likely to result from WTGs located to the north east. Nearby dwellings ILG003, ILG004 and ILG005 are all involved landowners.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is likely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is likely to have a high visual impact on the ridgeline and become a dominant element in the existing visual landscape.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP34	2	View from an elevated part of Uungula Road approximately 27 0m east of the entry to Dwelling UUN004.	Approximately 35 WTGs are likely to be visible, predominantly the east.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is likely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is likely to have a high visual impact on the ridgeline and is likely to become a dominant element in the visual landscape.
VP35	1	View from Uungula Road approximately 450 m south west of dwelling UUN005.	Proposed WTGs will be visible in all directions in varying distances from this location. There are no screening factors which will assist in screening views from this location.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is likely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is likely to have a high visual impact in all directions from this location and is likely to become a dominant element in the visual landscape.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP36	2	View from dwelling TMR023, located off Twelve Mile Road.	Approximately 30 WTGs would be visible to the south east (based on topography alone). Vegetation in the foreground would screen the majority of the visible WTGs.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have a major visual impact on key landscape features from this location.
VP37	2	view from Twelve Mile Road adjacent to dwelling TMR031 looking in a generally east direction.	Up to 30 WTGs are likely to be visible to the south east, partially screened by vegetation.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is likely to have a low-moderate visual impact however, unlikely to significantly modify the visual catchment from this location.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP38	2	View from driveway to dwelling TMR022 approximately 2.6 km south of Twelve Mile Road.	Approximately 30 WTGs will be visible to the south west, partially screened by topography and scattered vegetation.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is likely to have a low-moderate visual impact however, unlikely to become a dominant element in the visual landscape
VP39	2	View from unsealed road near dwelling TMR021 approximately 460 m from Twelve Mile Road.	Approximately 30 WTGs are likely to be visible beyond the hill in the middle ground.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is likely to have a low-moderate visual impact however, unlikely to become a dominant element in the visual landscape.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP40	2	View south from dwelling TMR020, located off Twelve Mile Road.	Views to the tips of approximately eight WTGs are available to the south (based on topography alone). Vegetation in the foreground is likely to fragment views.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is likely to have a low visual impact however, unlikely to become a dominant element in the visual landscape
VP41	2	Viewpoint off Guroba Road, approximately 60 m to the south east of the entry to dwelling UUN012.	The proposed WTGs will not be visible from this viewpoint due to topography.	The proposed WTGs will not be visible from this viewpoint.
VP42	2	Viewpoint off Guroba Road, at the entry to dwelling UUN009.	The proposed WTGs will not be visible from this viewpoint due to topography.	The proposed WTGs will not be visible from this viewpoint.
VP43	2	View from Uungula Road at dwelling UUN008.	Approximately 12 WTGS would be visible to the north west. Vegetation associated with Uungula Creek is likely to reduce the number of WTGs visible to the north west from this location.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is likely to have a moderate visual impact and the WTGs

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
				are likely to become a dominant element in the visual landscape.
VP44	2	View from Cudgegong River Park, located off Endacott Road approximately 5.4 km south of the Project.	Up to 14 WTGs will be visible on the vegetated ridge in the distance to the north west.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project may have a minor visual impact on key landscape features from this location.
VP45	2	View from Wuuluman Road approximately 300 m south of the entry to dwelling WUU008.	Approximately 30 WTGs would be visible to the east.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is likely to have a moderate visual impact and is likely to become a dominant element in the visual landscape.

Viewpoint	Visual Influence Zone (VIZ)	Description	Potential Visual Impact	Assessment Against Visual Performance Objectives
VP46	2	Viewpoint from elevated dwelling WUU001 located on a rise associated with the northern end of Dickerton Ridge.	Based on topography, it is likely the majority WTGs associated with the Project would be visible along the ridgeline in the distance. Views to a small number of WTGs in the south west of the Project Site would be obstructed by the Dickerton Ridge.	**Visual Magnitude:** Mitigation methods are to be considered for nearby residences. **Landscape Scenic Integrity:** The Project is unlikely to significantly modify the visual catchment from this location. **Key Feature Disruption:** The Project is unlikely to have any major visual impact on key landscape features from this location.

Figure 8-4: Viewpoint assessment locations (Moir Landscape Architecture, 2020)

8.2.3.3 Overview of Visual Impacts for each Landscape Character Unit

Table 8-6 outlines the overview of visual impacts for each LCU.

Table 8-6: Overview of visual impact for each LCU (Moir Landscape Architecture, 2020)

LCU	Visual Performance Objectives		
	Visual Magnitude	**Landscape Scenic Integrity**	**Key Landscape Features**
Wellington	-	The Project will not modify the visual catchment of this LCU.	The dramatic ridge associated with the Dickerton Range will remain a visually prominent landscape feature within this LCU.
Bodangora	Three non-involved dwellings are within 3.35 km of the Project and two non-involved dwellings are within 3.35 – 5 km of the Project.	The Project will be visible from several public and private viewpoints within this LCU. It is likely these will form part of the landscape, however they are unlikely to significantly modify the visual catchment of the area.	The Project may become a visual element in views towards the undulating hills towards the south from some viewpoints. For the most part, the undulating hills will remain the key landscape feature of this LCU.
Spicers Creek	All dwellings within this LCU are located over 5 km from the Project.	The Project is likely to be partially visible from a small number of residences and public viewpoints within this LCU. The Project is likely to form only a small element in the visual catchment and is unlikely to significantly modify the landscape.	The undulating grazing land, creek lines and scattered vegetation will remain the key landscape features of the area. The Project is likely to be a small element visible to varying levels from some areas, however, will not dominate the visual landscape.
Wuuluman	Three non-involved dwellings are within 3.35 km of Project and three non-involved dwellings are within	The Project is unlikely to significantly modify the visual catchment of this LCU.	The Project may be visible from some areas of this LCU; however, the hills and creek will remain the dominant feature of the landscape.

	3.35 – 5 km of the Project.		
Uungula	Three non-involved dwellings are likely to have views of the Project.	The Project is likely to become one of the more dominant elements in the landscape and is likely to alter the landscape character of this LCU. The most affected areas are those that are largely uninhabited.	The Project is likely to become a major element in the landscape of the area. The area within which the LCU is located is predominantly uninhabited and therefore opportunities to view the Project are contained to roads and residences. Due to the undulating topography, opportunities to view the Project in its entirety are unavailable from within this LCU.
Burrendong	All dwellings within this LCU are located over 5 km from the Project.	Views of Lake Burrendong, Cudgegong River and Meroo River are unlikely to be impacted. The Project will become a small visual element on the ridgeline to the north west of Cudgegong River Park.	Although there may be WTGs visible from some areas within the uninhabited land, views of Lake Burrendong and the distant vegetated ranges would remain the dominant landscape feature of the area. Billys Mountain, Pine Hill remain dominant features in the visual landscape.
Cudgegong	All dwellings within this LCU are located over 5 km from the Project.	The scenic integrity of the Cudgegong LCU is likely to be slightly modified by views to a varying number of proposed WTGs. The Project is likely to form a minor element in the overall visual landscape of this LCU.	The Cudgegong River and surrounding undulating topography will remain the dominant landscape features of this LCU.

8.2.3.4 Cumulative Impacts

Approved Wind Farm Developments within the Region

Potential cumulative landscape impacts of wind farms include:

- Combined visibility;
- Sequential visibility;
- The visual compatibility of different wind farms in the same vicinity;
- Perceived or actual change in land use across a character type or region; and
- Loss of characteristic element across a character type caused by developments across that character type.

Table 8-7 outlines the wind farm projects that are either operating or have recently received approval within the region.

Table 8-7: Approved wind farms within the region (Moir Landscape Architecture, 2020)

Project	Distance from Proposed Development	Size	Planning Status
Bodangora Wind Farm	9 km	33 WTGs	Operating
Crudine Ridge Wind Farm	>40 km	Up to 37 WTGs	Under Construction
Liverpool Range Wind Farm	>60 km	Up to 267 WTGs	Approved
Flyers Creek Wind Farm	>100 km	Up to 38 WTGs	Approved

Due to the proximity of the Bodangora Wind Farm, a cumulative ZVI assessment has been undertaken to identify areas in which both developments would be visible, based on topography alone (Figure 8-5). It was concluded that both Goolma Road and Twelve Mile Road have the highest potential for cumulative visual impacts. However, such impacts would be reduced by extensive roadside vegetation and distance. The Multiple Wind Turbine Tool identified 14 dwellings, which may be able to view both wind farms in two or more 60º sectors within 8 km of the Project. Of the 14 dwellings identified, only one was identified as having the potential to view three or more 60º sectors, being dwelling TMR022. However, further assessment concluded that vegetation surrounding this dwelling would make it unlikely that both wind farms will be visible, therefore, resulting in no cumulative visual impact.

Due to both the topography of the landscape and the distance between the Project and the other proposed wind farms, there is limited opportunity to view more than one proposed wind farm from a single viewpoint.

The region has the capability to visually accommodate the Project when assessed in combination with the other proposed developments without eroding the broad landscape character. The Project is generally obstructed from view by topography and existing vegetation from major transport routes. As the cumulative impact of the proposals in the region is low, wind farms as an element would not emerge as a dominant feature to visitors of the area. Subsequently it is unlikely the perceptions of the regions broad landscape character would be significantly altered as a result of the Project (Moir Landscape Architecture, 2020).

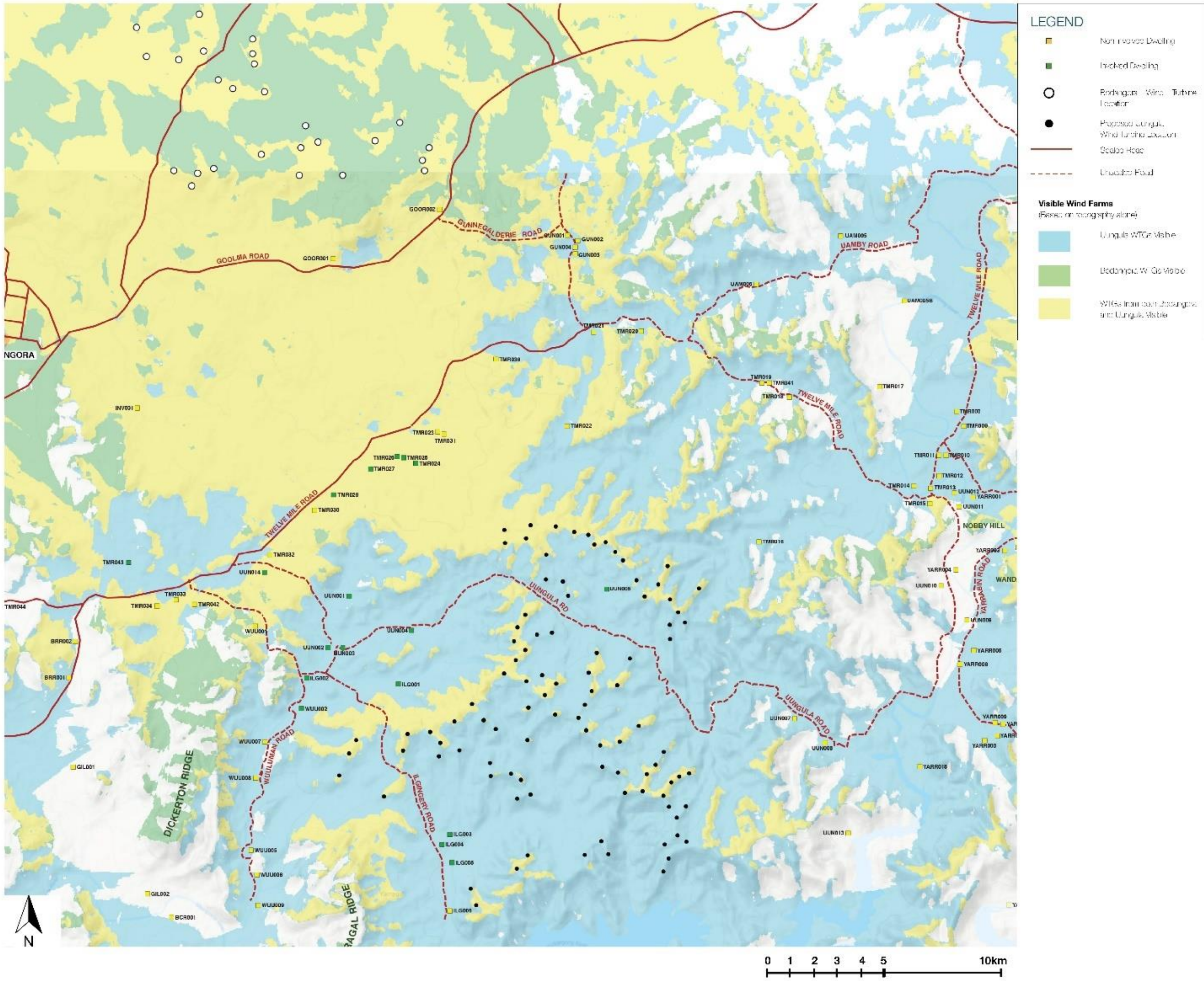


Figure 8-5: Cumulative ZVI assessment – Bodangora and Uungula Wind Farms (Moir Landscape Architecture, 2020)

Infrastructure

Due to the large scale and isolated sitting of the Project, associated infrastructure such as transmissions lines, access roads and other ancillary structures are also likely to contrast with the existing landscape.

Transmission Lines

Electrical and control cables will comprise a mix of underground and overhead transmission lines. The proposed transmission lines are visually similar to existing power line structures which are a common element throughout the existing visual landscape and will therefore appear as an extension of the existing power lines in the landscape. Visual impacts are thought to be minimal if the recommended mitigation measures outlined in Appendix R and Statement of Commitments outlined in Environmental Management (Section 9) are adhered to.

Ancillary Structures

Ancillary structures including Substations and switching stations are of a relatively small scale in the overall landscape. Visual impacts are thought to be minimal if the recommended mitigation measures outlined in Appendix R and Statement of Commitments outlined in Environmental Management (Section 9) are adhered to.

8.2.3.5 Shadow Flicker

A Shadow Flicker Assessment was undertaken in accordance with the Visual Assessment Bulletin (DPE, 2016b) to determine the level of impact of shadow flicker from the proposed WTGs on non-involved dwellings within 2 km of a WTG. In accordance with the Visual Assessment Bulletin (DPE, 2016b), shadow flicker at non-involved dwellings should not exceed 30 hours per year.

As a worst-case scenario, the Shadow Flicker Assessment was based on a viewing height of 1.7 m and on topography alone. Therefore, the extent of impact may be decreased by the following variables:

- The aspect of the residence relative to the WTG(s) (window locations, living area locations etc.);
- The extent of natural or screening vegetation between the WTG(s) and the receptor;
- The existence of other screening elements (buildings, structures etc.) between the WTG(s) and the receptor;
- The time of year;
- The proportion of daylight hours in which the WTGs operate; and

- The frequency of bright sunshine and cloudless skies (particularly at low elevations above the horizon).

A total of two dwellings may be impacted by shadow flicker affects caused by the Project, being ILG005 and UUN005, which are both involved landowners (Figure 8-6). Dwelling ILG005 is below the maximum standard of 30 hours per year. However, shadow flicker in excess of 100 hours per year could affect UUN005. Mitigation methods outlined in Appendix R, such as screen planting, would significantly reduce the annoyance caused by shadow flicker for UUN005.

The shadow flicker analysis also concluded that shadow flicker may occur on small sections of Uungula Road and Ilgingery Road. These roads have a low frequency of use and elements such as roadside vegetation would significantly reduce any potential shadow flicker. There is a negligible risk associated with distraction of motorists who experience shadow flicker.

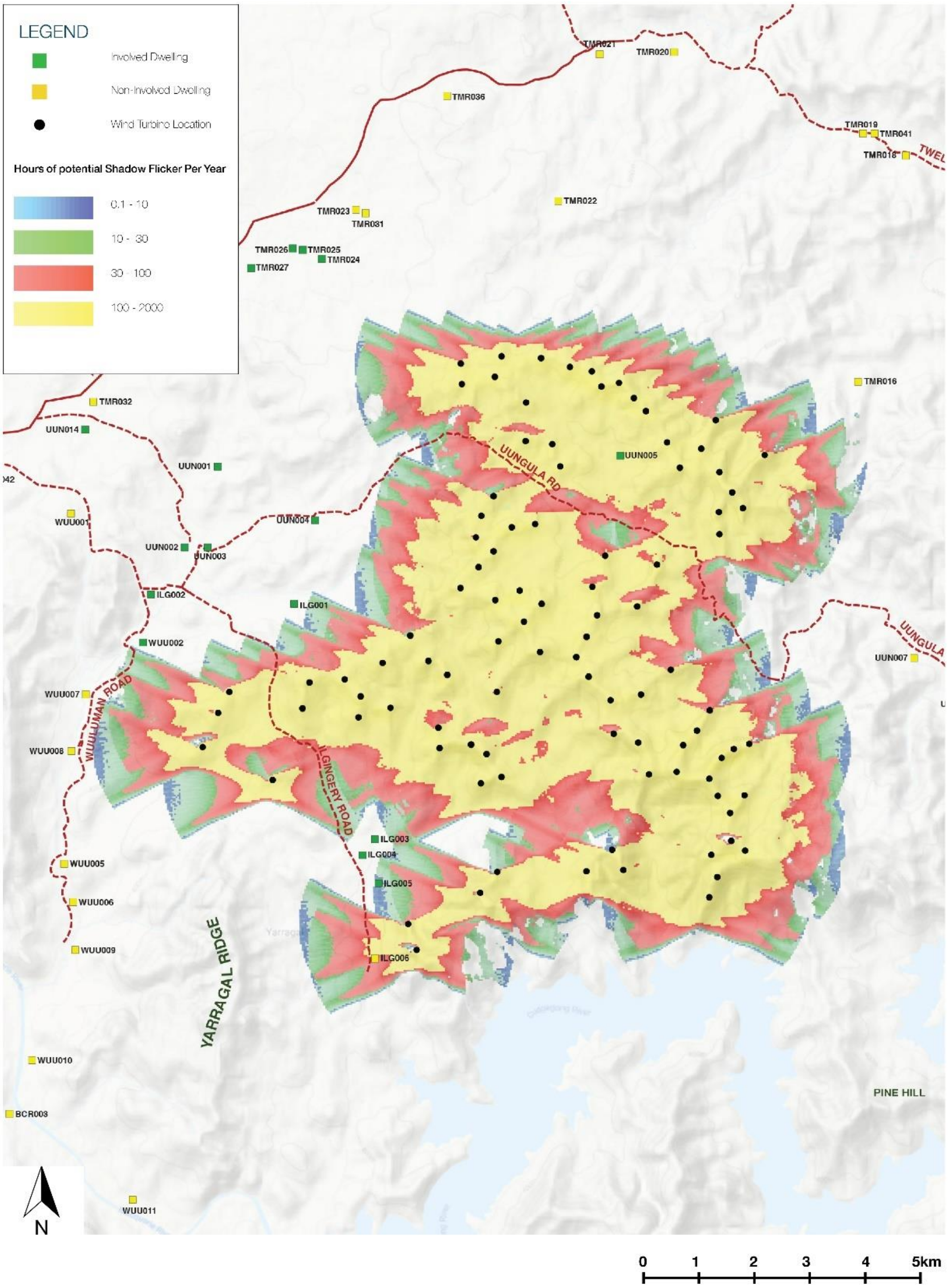


Figure 8-6: Shadow flicker assessment(Moir Landscape Architecture, 2020)

8.2.3.6 Blade Glint

Blade glint refers to the regular reflection off one or more rotating blades. This can be a temporary effect at any particular location, though the vast bulk of any glint occurs where the viewer is located above the altitude of the turbine hub. The occurrence of blade glint depends on a number of conditions, including the orientation of the nacelle, angle of the blade, and the angle of the sun. The Visual Assessment Bulletin (DPE, 2016b) recommends turbine blades be finished with a low reflectivity surface treatment to ensure any actual or perceived blade glint impact is minimised.

8.2.3.7 Night Lighting

Aviation Hazard Lighting

In accordance with the CASA Manual of Standard 139, aviation hazard lighting may be required on each WTG. However, the aeronautical requirements for marking and lighting of winds farms is under review by regulatory bodies as listed in Appendix O. Currently, CASA cannot mandate obstacle lighting on non-operationally significant wind farms, including this Project.

Installing aviation hazard lighting on the WTGs would potentially result in the alteration of the night-time landscape character of the region. It also has the potential to have a visual impact on receptors including motorists and residents. Site investigations carried out in operating wind farms in Victoria have suggested that although night time lighting mounted on WTGs may be visible for a number of kilometres from the wind farm project area, the actual intensity of the lighting appears no greater than other sources of night time lighting.

Existing night lighting is present in the Uungula area, associated with homesteads dispersed around the Project. Headlights and brake lights from vehicles travelling through the area along local roads also create an intermittent source of illumination. The visual impact from night lighting in the area is unlikely to have a significant visual impact on receptors including motorists and residents in the area.

Ancillary Infrastructure

Night-lighting is also likely to be required on Ancillary Infrastructure including switching stations, collector Substations and facilities buildings. At this stage of the project, the location and type of lighting required on collector Substations and facilities buildings is to be confirmed.

TransGrid and Essential Energy require the provision for night lighting that is not low intensity on the switching stations for operational safety reasons. This would only be used intermittently for operational and emergency maintenance reasons. Additionally, 24-hour low-intensity security night lighting or low intensity flood lighting would be incorporated into the design.

Proposed Ancillary Infrastructure has been carefully sited to minimise visibility from existing residences and publicly accessible viewpoints. It is unlikely the proposed night lighting associated with the Ancillary Infrastructure would create a noticeable impact on the existing night-time landscape.

8.3 Noise and Vibration

The Project is located in predominantly agricultural landscape, characterised by low background noise levels. Potential noise and vibration sources associated with the Project include those generated during construction activities, including construction traffic, Temporary Infrastructure, as well as operational phases through WTG noise and noise associated with the operation of Ancillary Infrastructure and routine on-site activities.

Concerns regarding noise generation have been raised through the community consultation process and are addressed throughout the evolution of the concept design for the Project. Potential noise and vibration impacts have been minimised throughout the concept design evolution process, with the objective to minimise impacts at nearby residences (Table 8-8). Despite the scale and duration of the project, the number of residences adversely impacted to the extent that further mitigation is required has been maintained at less than three.

Table 8-8: Non-associated residences impact minimisation changes over time – Noise impact assessment

	2013 249 WTG layout and 200m BTH	2018 127 WTG layout and 200m BTH	2018 125 WTG layout and 250m BTH	2019 117 WTG layout and 250m BTH	2019 109 WTG layout and 250m BTH	2020 97 WTG layout and 250m BTH
Number of Residences	4	NA	2	2	2	2

8.3.1 Introduction

The noise and vibration assessment has been prepared by Sonus Pty Ltd (2020), and has been undertaken in accordance with the requirements of the SEARs, which include:

- assess WTG noise in accordance with the *NSW Wind Energy: Noise Assessment Bulletin* (EPA/DPE, 2016c)
- assess noise generated by ancillary infrastructure in accordance with the *NSW Noise Policy for Industry* (EPA, 2017)
- assess construction noise under the *Interim Construction Noise Guidelines* (DECC, 2009)
- assess traffic noise under the *NSW Road Noise Policy* (DECCW, 2011)
- assess vibration under the *Assessing Vibration: A Technical Guideline* (DECC, 2006).

A full copy of the noise and vibration assessment is provided in Appendix S. This section provides a summary of the existing environment, methods, results and discussion of the noise and vibration impact assessment. Detailed mitigation and management measures are provided in Appendix S, and are summarised in Environmental Management (Section 9) as Statement of Commitments NV001 and NV002.

For assessment of potential health impacts from inaudible low frequency noise and/or infrasound from wind farms, refer to Section 8.6.

8.3.2 Existing Environment

8.3.2.1 Background Noise Monitoring

Background noise monitoring was conducted in accordance with the *NSW Wind Energy: Noise Assessment Bulletin* (Noise Assessment Bulletin) (DPE, 2016c), which adopts the methodology of the *South Australian Environment Protection Authority's Wind Farms – Environmental Noise Guidelines 2009* (SA, 2009). Monitoring was originally undertaken by Sonus at 15 monitoring locations as part of the 2013 Noise and Vibration Assessment of the previous WTG layout, which were selected based on preliminary noise predictions. The modification of the WTG layout resulted in several monitored locations becoming irrelevant therefore, Table 8-9 outlines the relevant monitoring locations for the Project.

Table 8-9: Background noise monitoring locations and periods (Sonus, 2020)

Residence ID	Residence Name	Coordinates (UTM WGS84 z55)		Monitoring Period
		Easting	Northing	
ILG001	Fashion's Mount	698565	6397763	12/9/2012 – 6/11/2012
TMR010	Belmont	713699	6403801	12/9/2012 – 6/11/2012
TMR019	Hope Royal	708735	6405892	10/10/2012 – 6/11/2012
UAM005	Mt Molly	710861	6409832	12/9/2012 – 3/11/2012
UUN009	Tilbelah	714173	6399311	12/9/2012 – 5/11/2012
UUN001	Glen Esk	714010	6402388	12/9/2012 – 6/11/2012
YARR003	Burra Murra	715225	6401187	12/9/2012 – 13/10/2012

Both the background noise level and wind speed were measured in 10-minute intervals. Wind speed was measured at two wind masts located within the Project Site at varying heights (Table 8-10). In accordance with SA 2009, the collected wind speed data was sheared using the power law wind profile model to derive the 10-minute average wind speed at 166 m hub height.

Table 8-10: Wind mast details (Sonus, 2020)

Mast ID	Coordinates (UTM WGS84 z55)		Measurement Height (m)
	Easting	Northing	
BER01	718673	6500552	30, 45, 61
WEL01	705654	6399971	30, 45

Local weather loggers, which measured rainfall and wind speed, were also deployed to determine the periods when weather may have influenced measured background noise levels in the vicinity. Data corresponding to weather interference was discarded.

The background noise level ($L_{A90,10}$) at a range of wind speeds within the operating range of the proposed WTGs is outlined in Table 8-11.

Table 8-11: Background noise levels (dB(A)) (Sonus, 2020)

Residence ID	Background Noise Level (dB(A)) for Integer Hub Height (166 m AGL) Wind Speed									
	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9m/s	10m/s	11m/s	12m/s
ILG001	27	27	28	28	29	30	30	31	32	33
TMR010	29	30	30	30	30	31	31	31	32	32
TMR019	25	26	26	27	27	37	27	28	29	30
UAM005	32	32	32	32	32	32	32	32	32	32
UUN009[6]	33	34	34	34	34	34	34	35	35	35
UUN001	28	28	28	28	28	28	29	29	29	30
YARR003	28	27	27	27	28	28	29	29	30	30

[6] High background noise levels were measured due to water noise from the adjacent river. It is understood that noise from flowing water is typically present at this location. Due to its specific nature, the background noise levels at this location have not been used to represent the background noise at any other location.

8.3.3 Potential Impacts

8.3.3.1 Wind Farm Noise

Noise Limits

The Noise Assessment Bulletin (DPE, 2016c) defines noise limits at relevant receiver locations (residences) as follows:

> *The predicted equivalent noise level ($L_{Aeq,10\ minute}$), adjusted for tonality and low frequency noise in accordance with these guidelines, should not exceed 35 dB(A) or the background noise ($L_{A90(10\ minute)}$)) by more than 5 dB(A), whichever is the greater, at all relevant receivers for wind speed from cut-in to rated power of the wind turbine generator and each integer wind speed in between.*

The sound power level data of three WTG models was analysed, which included the *Vestas V162-5.6MW, Siemens Gamesa 170 6.0MW* and *General Electric GE5.5-158.* As a worst-case scenario, the model with the highest sound power level, being the *Vestas V162-5.6MW*, was used for the assessment.

Noise predictions from the Project were determined using the CONCAWE noise propagation model and SoundPLAN noise modelling software, which considers the following:

- sound power levels and locations of noise sources;
- separation distances between noise sources and receivers;
- topography of the area;
- influence of the absorption provided by the ground;
- air absorption; and
- meteorological conditions.

The following assumptions were input into the prediction model:

- weather category 6 (night with no clouds and wind from the wind farm to the dwelling under consideration);
- atmospheric conditions at 10°C and 80% relative humidity;
- wind direction from all WTGs directed towards the particular residence under consideration, even in circumstances where WTGs are located in opposite directions from the residence;
- acoustically soft ground to reflect the pastoral nature of the land; and
- maximum barrier attenuation from topography of 2 dB(A).

The Project will comply with the noise criteria at all but one non-associated dwelling, ILG006 (for a wind speed of 7 m/s and above). It is understood that ILG006 is a derelict house on land owned by Water NSW and is therefore not considered to be a relevant sensitive receptor. Based on these circumstances, the operation of the Project will achieve the project noise criteria at all relevant recievers (Figure 8 7 to Figure 8 12).

Tonality and Low Frequency

The Noise Assessment Bulletin (DPE, 2016c) prescribes a 5 dB(A) penalty adjustment (added to the measured or predicted noise level) for the presence of repeated and excessive tonality and/or low frequency which occurs for more than 10% of an assessment period.

Excessive tonality is present at a particular one-third octave band level if the band level exceeds the adjacent bands on both sides by at least:

- 5 dB, if the centre frequency of the band is in the range 500 Hz to 10,000 Hz;
- 8 dB, if the centre frequency of the band is in the range 160 Hz to 400 Hz; and/or
- 15 dB, if the centre frequency of the band is in the range 25 Hz to 125 Hz.

The penalty for tonality only applies if the tone from the wind farm is audible at the receiver location. The absence of a tone at an intermediate location will be sufficient to demonstrate that the Project noise at the relevant receiver location is non-tonal.

The predictions were conducted without a penalty applied for the presence of excessive tonality. To provide certainty, it is recommended that a guarantee is sought from the manufacturer as part of the procurement process (Sonus, 2020). The general form of the guarantee should be that a penalty for tonality is not applicable at any residence when tested in accordance with the methodology of the Noise Assessment Bulletin (DPE, 2016c).

Excessive low frequency noise is present if the low frequency noise levels at non-associated residences exceed 60 dB(C). The highest predicted low frequency noise level at non-associated residences is 53 dB(C) at ILG006, which is less than 60 dB(C) and therefore a penalty for excessive low frequency noise is not applicable.

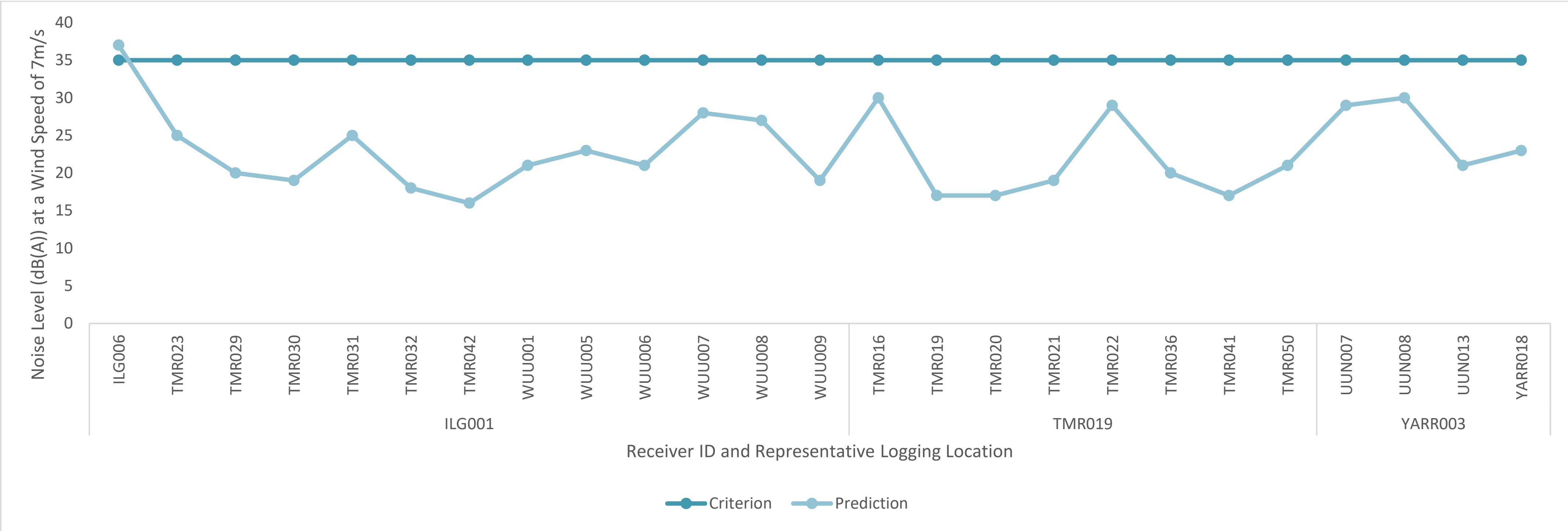


Figure 8-7: Predicted noise levels (dB(A)) at a wind speed of 7 m/s (Sonus, 2020)

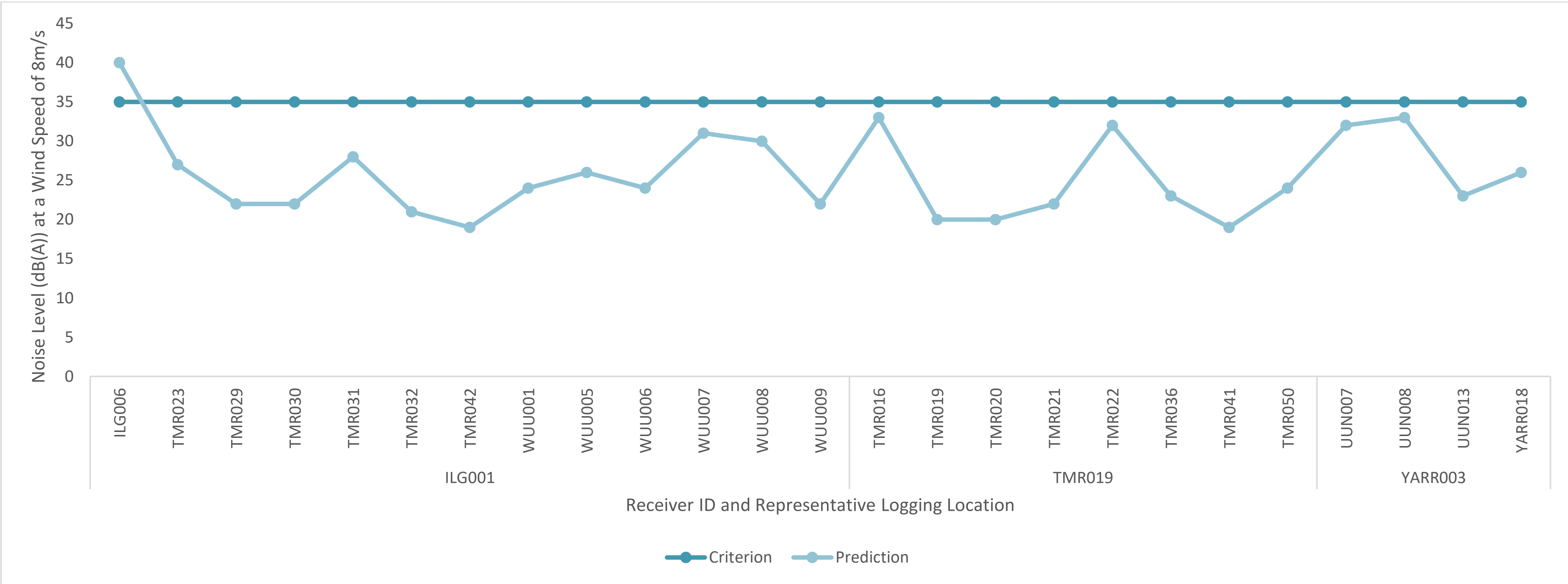


Figure 8-8: Predicted noise levels (dB(A)) at a wind speed of 8 m/s (Sonus, 2020)

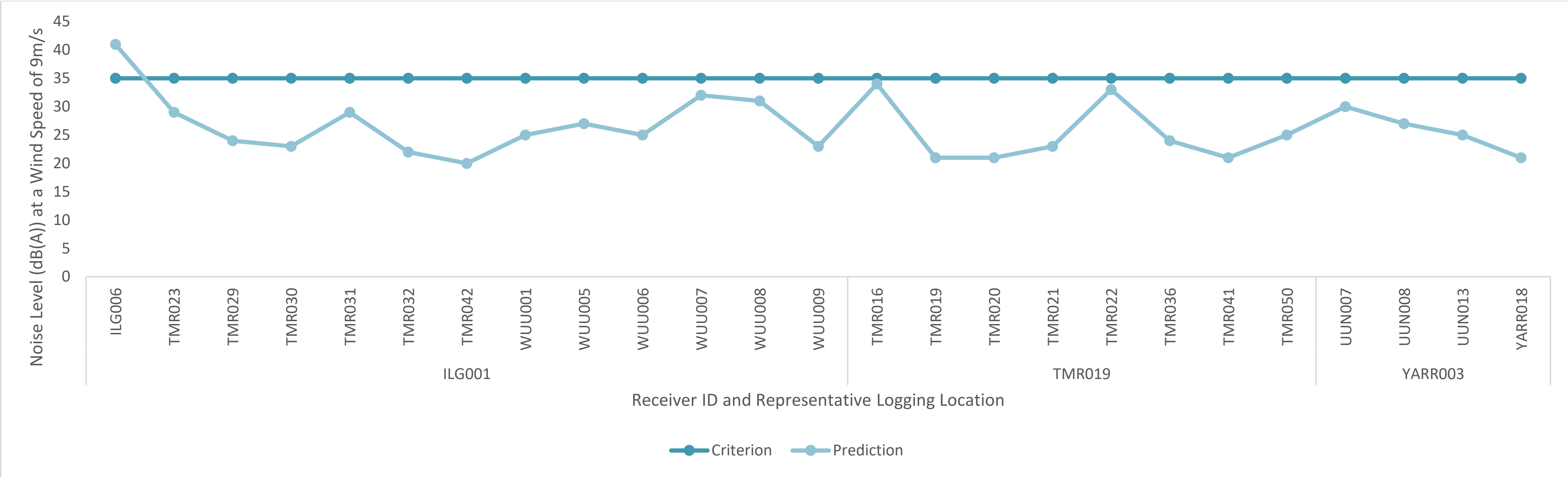


Figure 8-9: Predicted noise levels (dB(A)) at a wind speed of 9 m/s (Sonus, 2020)

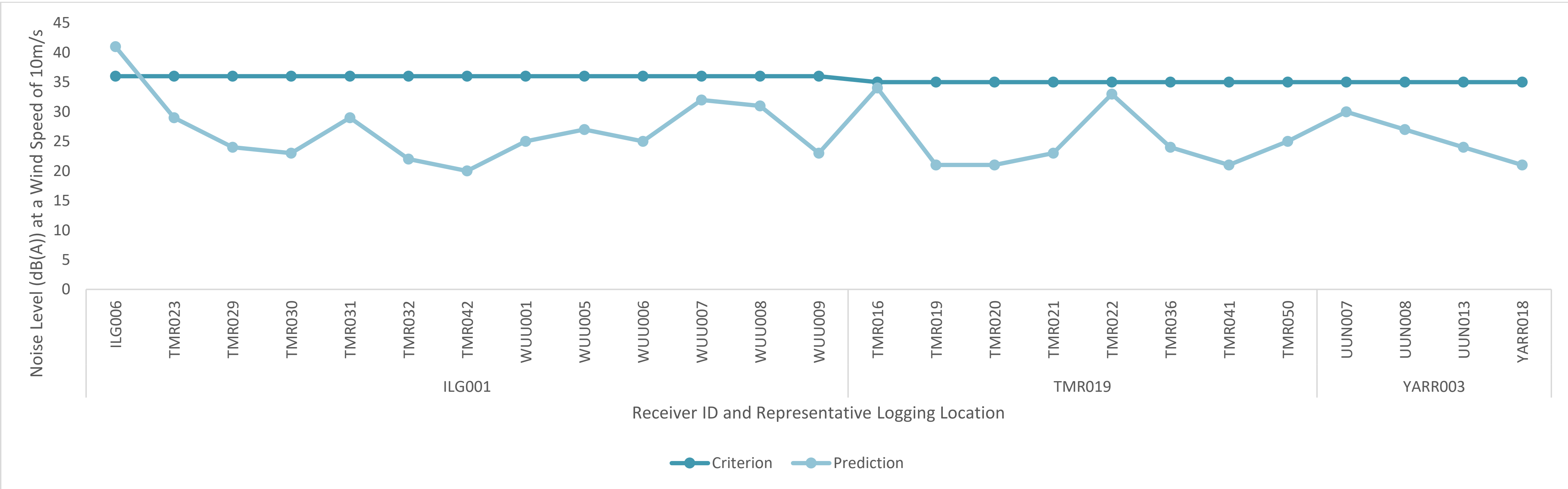


Figure 8-10: Predicted noise levels (dB(A)) at a wind speed of 10 m/s (Sonus, 2020)

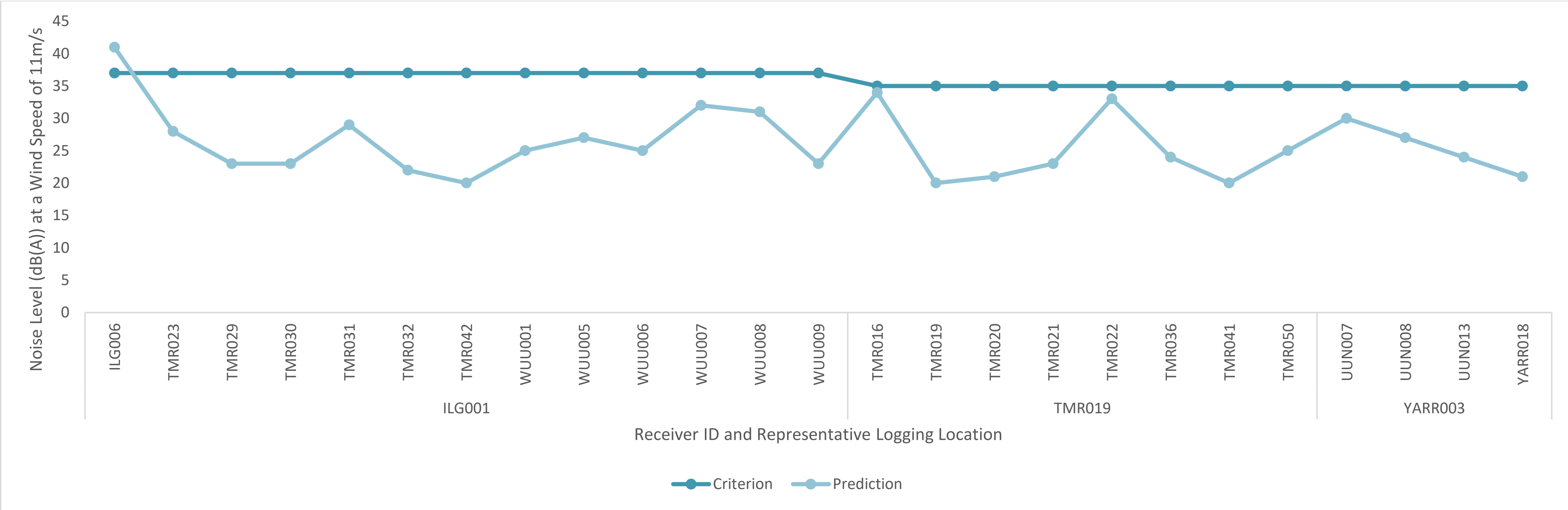


Figure 8-11: Predicted noise levels (dB(A)) at a wind speed of 11 m/s (Sonus, 2020)

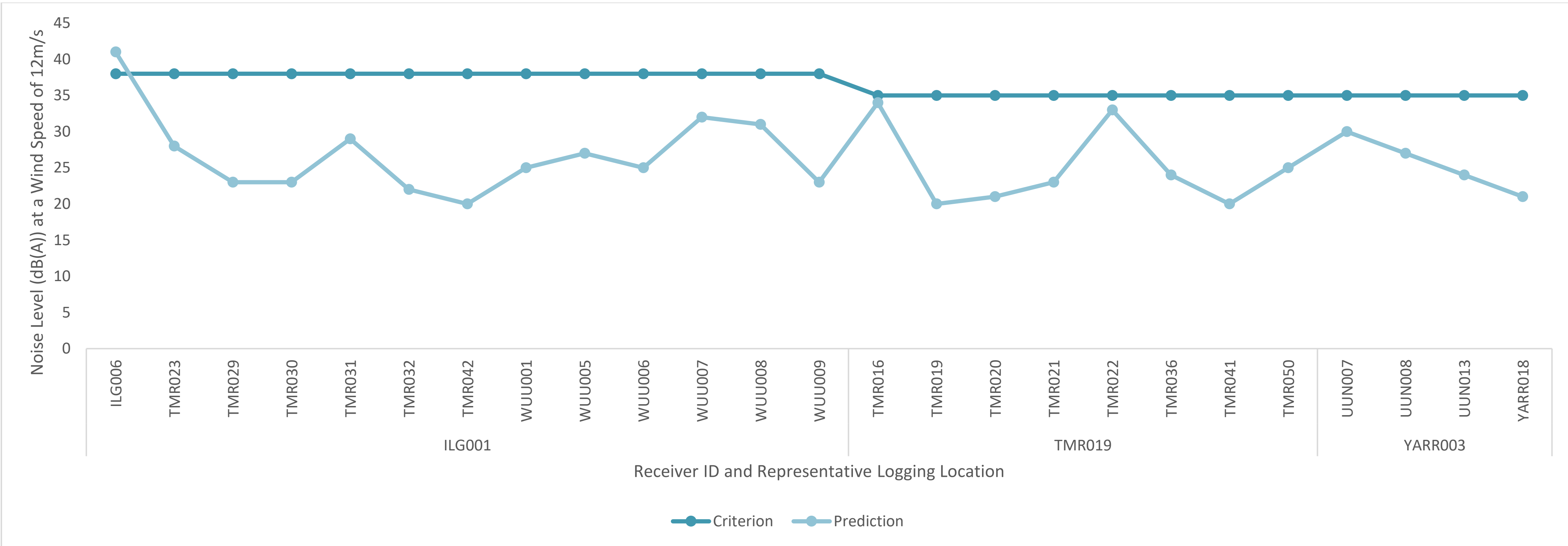


Figure 8-12: Predicted noise levels (dB(A)) at a wind speed of 12 m/s (Sonus, 2020)

8.3.3.2 Ancillary Infrastructure

The noise assessment for Ancillary Infrastructure was undertaken in accordance with the NSW *Noise Policy for Industry* (EPA, 2017), in accordance with the Noise Policy for Industry, a Rating Background Level (RBL) of 30 dB(A) was applied for all dwellings for this assessment.

The main sources of noise from the proposed Ancillary Infrastructure will be the Substations (in particular the two 300 Mega-Volt-Ampere (MVA) rated transformers) and the ESF (in particular the battery inverters with a combined capacity of up to 150 MW). The assumed octave band sound power levels for both equipment is outlined in Table 8-12.

Table 8-12: Transformer and battery inverter sound power levels (Sonus, 2020)

Equipment	Sound Power Level (dB(A)) for each Octave Band Centre Frequency (Hz)								
	63	125	250	500	1000	2000	4000	8000	Total Sound Power Level dB(A)
Transformer 300 MVA	79	87	95	97	89	86	79	75	100
Inverters 150 MW	79	87	99	97	98	100	108	97	110

Given the final locations are not yet known and to provide flexibility in the detailed design, predictions have been made based on all locations being used, although this is unlikely to occur. The noise level is predicted to be no more than 24 dB(A) at any residence, from the combined operation of all three substations and two energy storage facilities. Based on these predictions, the criterion of 30 dB(A) will be achieved at all locations and the operation of the Ancillary Infrastructure will not adversely impact the amenity of residences within the locality of the substation and ESF.

8.3.3.3 Construction Noise

The construction of the Project will comprise of activities such as road construction, civil works, excavation, foundation construction, electrical infrastructure works and WTG erection requiring processes such as heavy vehicle movements, crushing and screening, possible concrete batching, loaders, excavators, generators, cranes and, subject to local conditions, possibly blasting.

Potential construction noise was assessed in accordance with the *Interim Construction Noise Guideline* (ICN Guideline) (DECC, 2009). For the purposes of this assessment a worst-case (highest noise level) scenario is adopted whereby it is assumed that all construction equipment is present and operating simultaneously on site for each stage of construction.

The predicted noise levels are based on a separation distance between the closest proposed WTG and non-associated dwelling, which is approximately 1,000 m. In accordance with the ICN Guidelines, the noise level criterion is 40 dB(A), which is 10 dB(A) above the RBL. Table 8-13 outlines the predicted noise levels at 1,000 m and the required separation distance in order to achieve the 40 dB(A) criterion. A separation distance greater than 1,000 m will result in lower noise levels than those presented.

Table 8-13: Predicted construction noise levels (Sonus, 2020)

Phase	Main Plant and Equipment	Predicted Noise Level at 1,000 m (dB(A))	Separation to Achieve 40 dB(A) Criterion (m)
Site set-up and civil works	• Generator • Transport truck • Excavator • Low Loader	44	1,600
Road and hard stand construction	• Mobile crushing & screening plant • Dozer • Roller • Low Loader • Tipper Truck • Excavator • Scraper • Transport truck	49	2,400
Excavation and foundation construction	• Excavator • Front end loader • Concrete batching plant • Mobile crushing & screening plant • Truck-mounted concrete pump • Concrete mixer truck • Mobile crane • Transport truck • Tipper truck	49	2,400

Phase	Main Plant and Equipment	Predicted Noise Level at 1,000 m (dB(A))	Separation to Achieve 40 dB(A) Criterion (m)
Electrical installation	• Rock trencher • Concrete mixer truck • Low loader • Tipper truck • Mobile crane	49	2,400
WTG delivery and erection	• Extendable trailer truck • Low loader • Mobile crane	45	1,800

As outlined in Table 8-13, construction noise will exceed 40 dB(A) at a distance of 1,000 m. However, the predicted noise levels are significantly less than the 75 dB(A) upper limit outlined within the ICN Guideline.

Dwellings located between 1,000 m and 2,400 m may be defined as 'noise affected' in accordance with the ICN Guideline, which require the proponent to apply all feasible and reasonable work practices, and to inform the residents of the proposed construction work. The following may be considered as 'feasible' and 'reasonable' noise control strategies:

- engineering measures such as the construction of temporary acoustic barriers, the use of proprietary enclosures around machines, the use of silencers, the substitution of alternative construction processes and the fitting of broadband reversing signals; and
- administrative measures such as inspections, scheduling and providing training to establish a noise minimisation culture for the works.

8.3.3.4 Traffic Noise

Traffic noise was assessed in accordance with the NSW *Road Noise Policy* (DECCW, 2011), which provides both day and night assessment criteria based on road category and relative increase to the existing traffic noise levels. For instances where the Project has the potential to increase traffic activity on existing local roads, the criteria outlined Table 8-14 is recommended. This criterion is to be achieved outside of the residence, at a distance of 1 m from the façade, at a height of 1.5 m from the ground.

Table 8-14: Road traffic noise criteria (Sonus, 2020)

Period	Criterion Based on Road Category (dB(A))	Relative Increase Criterion (dB(A))
Day (7 am – 10 pm)	$L_{Aeq(1hour)}$ 55	Existing traffic $L_{Aeq(1hour)}$ + 12 dB
Night (10 pm – 7 am)	$L_{Aeq(1hour)}$ 50	Existing traffic $L_{Aeq(1hour)}$ + 12 dB

The Project has the potential to impact on road traffic noise during construction through the increase of both passenger vehicle and heavy vehicle movements to and from the site. Such vehicles will include semi-trailers, low loaders, haulage trucks, mobile cranes, water tankers, four-wheel-drive vehicles and passenger vehicles.

It is predicted that at 10 m from the roadside, the daytime criterion can be achieved for ten passenger vehicle movements and three heavy vehicle movements per hour. The number of vehicle movements can double for every doubling of distance from the roadside and continue to achieve the 55 dB(A) criterion. That is, 20 passenger vehicles and six heavy vehicle movements could be accommodated per hour at a dwelling that is 20 m from the roadside (Sonus, 2020).

8.3.3.5 Vibration

The vibration assessment was undertaken in accordance with the *Assessing Vibration: A Technical Guideline* (DECC, 2006). The Guideline does not have mandatory standards nor set objective criteria, but rather is focussed on setting feasible and practicable vibration reduction measures. The Guideline provides goal vibration levels based on the following definitions:

- **Continuous Vibration:** Uninterrupted for an extended period of time;
- **Intermittent Vibration:** An interrupted form of continuous vibration; and
- **Impulsive Vibration:** A sudden event or events.

For construction activity occurring during the daytime, the Guideline provides the vibration criteria outlined in Table 8-15.

Table 8-15: Vibration criteria (Sonus, 2020)

Continuous mm/s^2 Vertical (rms.)	Impulsive mm/s^2 Vertical (rms.)	Intermittent $mm/s^{1.75}$ Vibration Dose Value
10-20	30-60	0.2-0.4

The main sources of vibration from the Project are likely to be the rock trenching equipment, rock breaking/blasting and roller operation during the road and hard stand construction. The level of vibration at a distance will be subject to the energy input of the equipment and the local ground conditions.

To achieve the construction vibration criteria outlined in Table 8-15, construction activities are required to be at least 20 m from the nearest residences. At 100 m, vibration for the above listed activities is unlikely to be detectable to humans. The nearest residences are more than 100 m away from the construction activities therefore, the criterion is expected to be easily achieved (Sonus, 2020).

If construction activities producing high levels of vibration occur within 100 m of a dwelling, it is recommended that a monitoring regime is implemented during these times to ensure compliance with the Guideline.

8.4 Biodiversity

8.4.1 Introduction

The Biodiversity assessment has been prepared by ELA (ELA, 2020), and has been undertaken in accordance with the requirements of the SEARs, which include:

- *assess biodiversity values and the likely biodiversity impacts of the development in accordance with the NSW Biodiversity Offsets Policy for Major Projects (OEH, 2014) and Framework for Biodiversity Assessment (OEH, 2014), unless otherwise agreed by the Biodiversity and Conservation Division (BCD) (terrestrial biodiversity) or DPI Fisheries (aquatic biodiversity); and*
- *assess the impact of the development on birds and bats, including blade strike, low air pressure zones at the blade tips (barotrauma), alteration to movement patterns, and cumulative impacts of other wind farms in the vicinity.*

A Biodiversity Assessment Report (BAR) and BOS have been developed in accordance with the NSW FBA in response to the Project SEARs. The BAR includes a comprehensive assessment of native vegetation, threatened species and vegetation communities which may be impacted by the Project, and calculation of the offset requirements for the current Development Footprint of 659 ha (note that the Development Footprint used in this BAR includes the area of clearing required for the External Road Upgrades along Twelve Mile Road between Goolma Road in the west and the Primary Project Site Entry). The BOS presents an overview of the strategy available to CWP to appropriately retire biodiversity offsets for the Project. The findings of the BAR and BOS are summarised in this chapter, and the full report is included in Appendix G.

It is noted that bird and bat strike associated with wind farm developments are not assessed under the FBA as detailed in Section 2.3 of the FBA. Prior to the commissioning of any WTGs, the Proponent will prepare a BBAMP for the Project in consultation with DPIE, and to the satisfaction of the Secretary.

This BBAMP will include:

- a detailed description of the measures that would be implemented on-site for minimising bird and bat strike during operation of the development, including:
    - minimising the availability of raptor perches on WTGs;
    - prompt carcass removal;
    - controlling pests; and
    - using best practice methods for bat deterrence, including managing potential lighting

impacts;

- trigger levels for further investigation of the potential impacts of the project on particular bird or bat species or populations;
- an adaptive management program that would be implemented if the development is having an adverse impact on a particular threatened or 'at risk' bird and/or bat species or populations; including the implementation of measures to:
    - reduce the mortality of those species or populations; or
    - enhance and propagate those species or populations in the locality; and
- a detailed program to monitor and report on:
    - the effectiveness of these measures; and
    - any bird and bat strikes on-site;
- provisions for a copy of all raw data collected as part of the monitoring program to be submitted to OEH and the Secretary.

Detailed mitigation and management measures are provided in Appendix G, and are summarised in Environmental Management (Section 9) as Statement of Commitments BM001, BM002, BM003 and BM004.

8.4.2 Background

The Project was assessed under the former BioBanking Assessment Methodology (BBAM) (DECC 2009) in 2013 by Environmental Resources Management Pty Ltd (ERM), on a Study Area roughly three times the size of the current Development Footprint. The ERM assessment included a significant field survey effort, which although completed in 2012 – 2013, has been considered within this EIS. In particular, vegetation mapping and the data collected from vegetation plots under the BBAM has been used, which is consistent with the FBA plot data collection methodology. Consultation was undertaken with the (former) NSW OEH in October 2018 regarding the use of the ERM data for this assessment. It was concluded that the ERM survey effort from 2012 – 2013 was adequate and the data remained relevant for the assessment. Supplementary field survey was only required to address gaps due to changes in the Development Footprint.

8.4.3 Study Area

The Study Area subject to the biodiversity assessment included all infrastructure associated with the Project within a 100 m Development Corridor, Ancillary Infrastructure such as transmission lines and proposed public road upgrades extending outside of the Development Corridor. The Study Area further extends to include the extent of native vegetation mapped for the ERM assessment, within which threatened species surveys were undertaken. Roughly two thirds of the area assessed by ERM has since been removed from the Project Design, however is still deemed relevant for the assessment of biodiversity, in particular, vegetation mapping and data.

The current Development Footprint is indicative only and subject to change during the detailed design process. The Development Corridor extends 100 m either side of the current indicative Development Footprint to support flexibility in the design and final placement (micro siting) of the above components. Flexibility is sought in the Development Consent to allow the Proponent to determine the optimal project layout within the limits of the impact assessment and Development Consent, generally in accordance with this EIS, post-Development Consent. The Proponent requests flexibility within pending consent conditions that the timing of determining final offset requirements and offsets is cognisant of the detailed design process.

The Study Area, including the Development Footprint, Development Corridor and extent of vegetation mapped for the ERM assessment, is shown below in Figure 8-13.

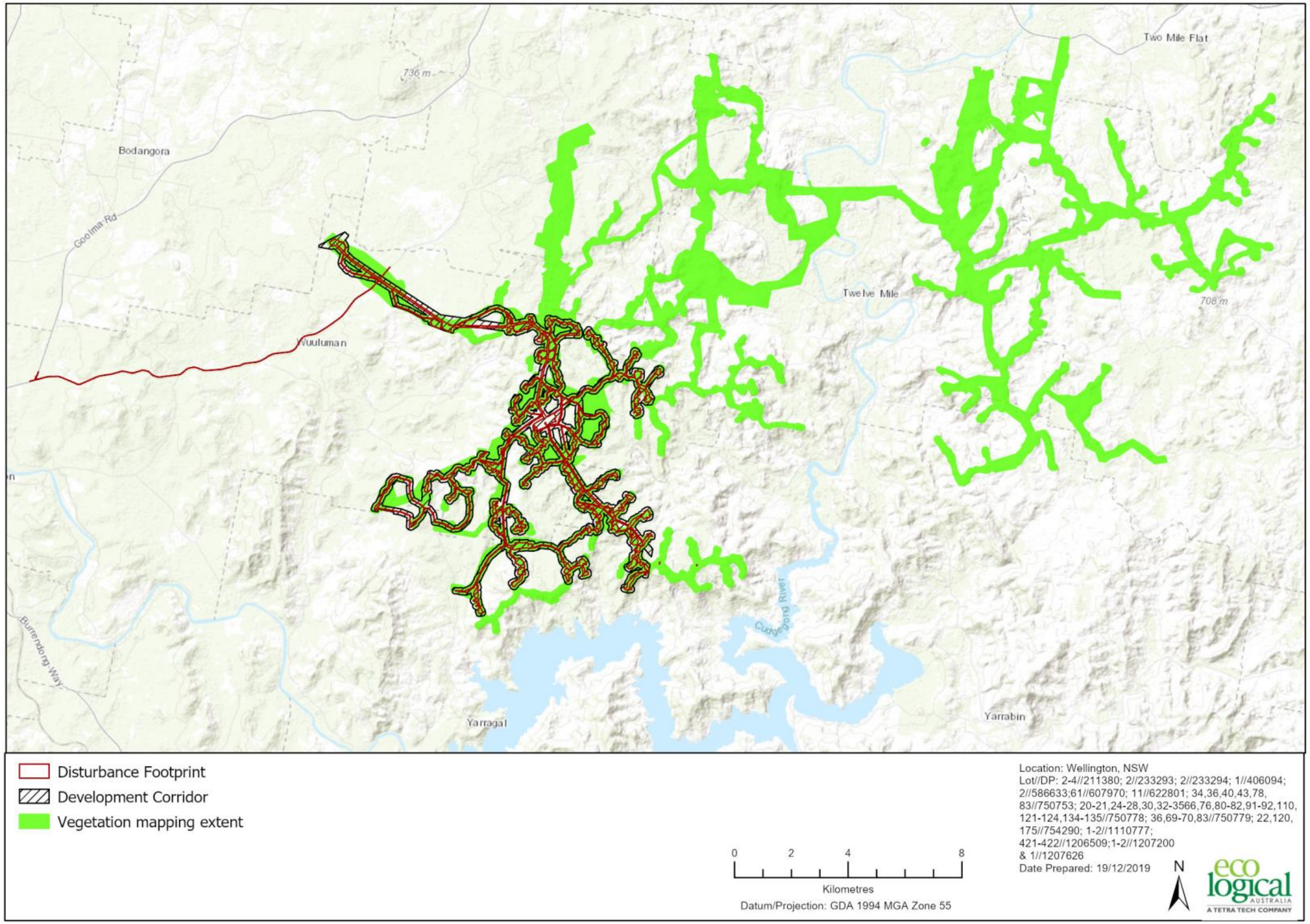


Figure 8-13: Biodiversity study area

8.4.4 Survey Effort

Vegetation surveys were undertaken by ERM in 2012 and 2013 across the Study Area, roughly three times the size of the current Development Footprint. Vegetation was mapped to Biometric Vegetation Type (BVT) and stratified according to condition class to identify vegetation zones.

High level validation of the ERM vegetation mapping was undertaken over a series of field surveys in select portions of the Study Area in September and October 2018 by ELA ecologists, led by Senior Botanist David Allworth and Senior Ecologist Dr Cheryl O'Dwyer. Detailed survey and vegetation mapping for the length of the proposed upgrade to Twelve Mile Road and Ilgingery Road was undertaken by ELA in July 2019, led by ecologists Lily Gorrell and Tomas Kelly. Further field vegetation validation was undertaken by ELA in January 2020 to address select gaps in the vegetation mapping from the revised Development Footprint, led by ecologist Tomas Kelly.

ELA vegetation assessment methodology included rapid assessments to determine vegetation type, extent and condition. Rapid assessments were undertaken against the listing criteria for TECs under both the BC Act and the EPBC Act. Rapid assessments involved describing the vegetation structure, topographic position, soils and any other relevant abiotic factors.

The ERM assessment included targeted surveys for threatened species in 2012 and 2013 in the greater Study Area in accordance with the methodology prescribed by the DGRs issued in 2011 (superseded by the current Project SEARs). The ERM assessment identified areas of potential threatened species habitat within the Study Area to guide the threatened species surveys. All surveys were undertaken between October 2012 and March 2013 unless specified otherwise:

- Threatened flora survey:
    - Random meander, total of 76.1 km of meander transects undertaken for 67 meander transects.
- Bird surveys:
    - Bird Utilisation Surveys: Two observers recording abundance of bird species for 15 minutes at 28 fixed survey points, over 16 days.
    - Woodland bird surveys: Total of 24 surveys employing 20 minutes of active searching a 2 ha area, including nest searches.
    - Call playback and spotlighting over nine nights.

- Microbats:
    - Songmeter recordings at 26 locations between November and February, undisclosed frequency.
    - Potential roost site surveys – active daytime searches of disused mine adits within the Study Area, followed by 30 minutes of active watching at dusk over two evenings.
    - Harp trap at potential roost sites over two nights.

- Mammals:
    - Static camera traps at 25 sites, 21 within woodland or forested areas, four within pasture with scattered trees. Deployed for 70 hours each, 73 full days of data collection. Camera traps were baited with dead chicken to attract *Dasyurus maculatus* (Spotted-tailed Quoll).
    - Spotlighting at seven locations over nine nights, 35 person hours.

- Koala survey:
    - Spotlighting surveys conducted over 9 nights (35 person hours).
    - Koala scat searches conducted around 82 trees in three separate areas. Radius of one metre around base of tree searched by two ecologists until scat found or two minutes was reached.

8.4.5 Existing Environment

8.4.5.1 Native Vegetation

A combined vegetation mapping GIS layer was compiled for the Study Area. Five BVTs were identified:

- CW112 - Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion;
- CW177 - Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion;
- CW202 - Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland of hills of the South Western Slopes;
- CW211 - White Box - Rough-barked Apple alluvial woodland on the NSW western slopes; and
- CW212 - White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes.

Vegetation was stratified into 13 vegetation zones based on vegetation condition. A total of 105 plots and transects were completed by ERM within the Study Area according to the required number by area in each vegetation zone prescribed by the BBAM. Data collected from BBAM plots is consistent with the plot/transect data required for entry into the BBCC for the FBA, therefore the ERM collected data has been used for the BAR (Appendix G). In accordance with the number of plots required per vegetation zone prescribed in Table 3 of the FBA, a total of 49 plots were used in this assessment. No plots/transects have been completed by ELA.

Vegetation zones and areas within the current Development Footprint are detailed below in Table 8-16 and shown within the Development Corridor in Figure 8-14. A map book containing detailed mapping of the vegetation to be affected by the proposed upgrade to Twelve Mile Road, is included in the BARBOS in Appendix G.

Table 8-16: Summary of vegetation zones within Development Footprint

Vegetation Zone	BVT	Description	Condition	Conservation Status BC Act	Conservation Status EPBC Act	Approx. Area (ha)	Plots required[7]	Plots completed[8]
1	CW112	Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion	Moderate/Good _Moderate	White Box Yellow Box Blakely's Red Gum Woodland	White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	3.57	2	2
2	CW112	Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion	Moderate/Good _Poor	-	-	64.72	5	5
3	CW177	Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion	Moderate/Good _Medium	-	-	18.69	3	3
4	CW177	Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion	Moderate/Good _Poor	-	-	26	4	4
5	CW177	Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion	Moderate/Good _Other	-	-	7.21	3	3

[7] Per Table 3 FBA

[8] ERM 2013

Vegetation Zone	BVT	Description	Condition	Conservation Status BC Act	EPBC Act	Approx. Area (ha)	Plots required[7]	Plots completed[8]
6	CW202	Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland of hills of the South Western Slopes	Moderate/Good _ Moderate	-	-	16.66	3	3
7	CW202	Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland of hills of the South Western Slopes	Moderate/Good _Poor	-	-	11.27	3	3
8	CW211	White Box - Rough-barked Apple alluvial woodland on the NSW western slopes	Moderate/Good _ Moderate	White Box Yellow Box Blakely's Red Gum Woodland	White Box-Yellow Box-Blakely’s Red Gum Grassy Woodland and Derived Native Grassland	7.68	3	3
9	CW211	White Box - Rough-barked Apple alluvial woodland on the NSW western slopes	Moderate/Good _Poor	-	-	48.55	4	4
10	CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes	Moderate/Good _ Moderate	White Box Yellow Box Blakely's Red Gum Woodland	-	13.05	3	3
11	CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes	Moderate/Good _Poor	-	-	310.35	7	7

Vegetation Zone	BVT	Description	Condition	Conservation Status BC Act	EPBC Act	Approx. Area (ha)	Plots required[7]	Plots completed[8]
12	CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes	Moderate/Good _Other	-	-	72.83	5	8
13	CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes	Low	-	-	38.31	4	4
					TOTAL	**639**	**49**	**52**

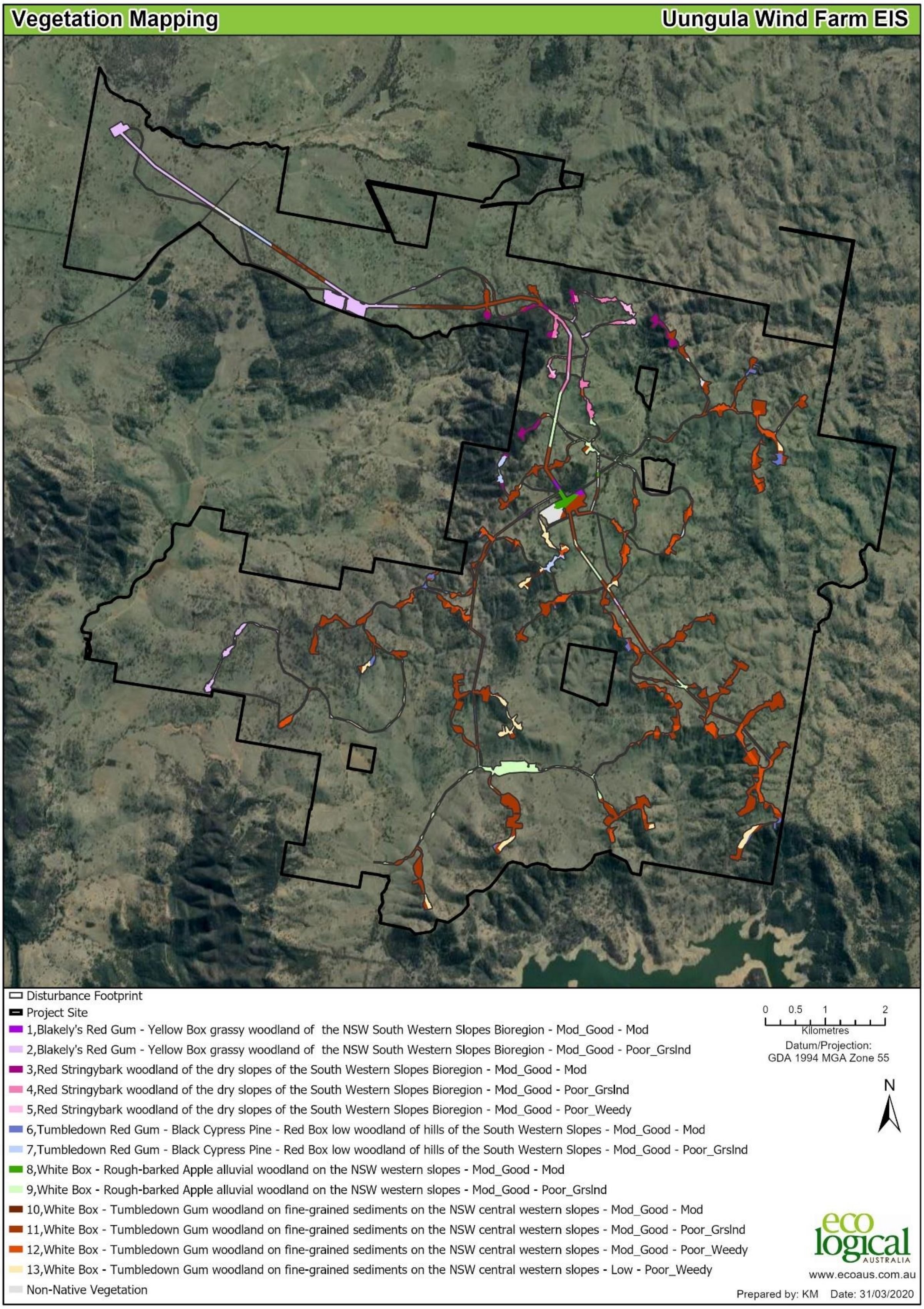


Figure 8-14: Vegetation mapping for the development corridor

8.4.5.2 Threatened Ecological Communities

Mapped TECs are listed against relevant BVTs above in Table 8-16 and are shown below in Figure 8-15. Approximately 24.3 ha of the vegetation has been mapped as TEC listed under the BC Act:

- White Box Yellow Box Blakely's Red Gum Woodland - listed as an Endangered Ecological Community (EEC).

Approximately 11.25 ha of this TEC has been mapped as the EPBC Act listed community:

- White Box - Yellow Box - Blakely's Red Gum Grassy Woodland and Derived Native Grassland - listed as a Critically Endangered Ecological Community (CEEC).

Vegetation zone 10, mapped as BVT CW212 Moderate/Good_Moderate, was mapped by ERM as conforming to the NSW (now BC Act) TEC, but not to the EPBC Act TEC due to its presence on ridges and hilltops with skeletal soils, not highly fertile soils as specified by the listing criteria (Threatened Species Scientific Committee 2006).

Further assessment and refinement of EEC / CEEC mapping will be undertaken for the detailed design. The assessment of impacts to the TEC has been undertaken on an assumption that the area may increase by up to 25%, to 30 ha (14 ha of the CEEC), under the detailed design; however, this has not been included in the credit calculation as it is unable be assigned to a particular vegetation zone.

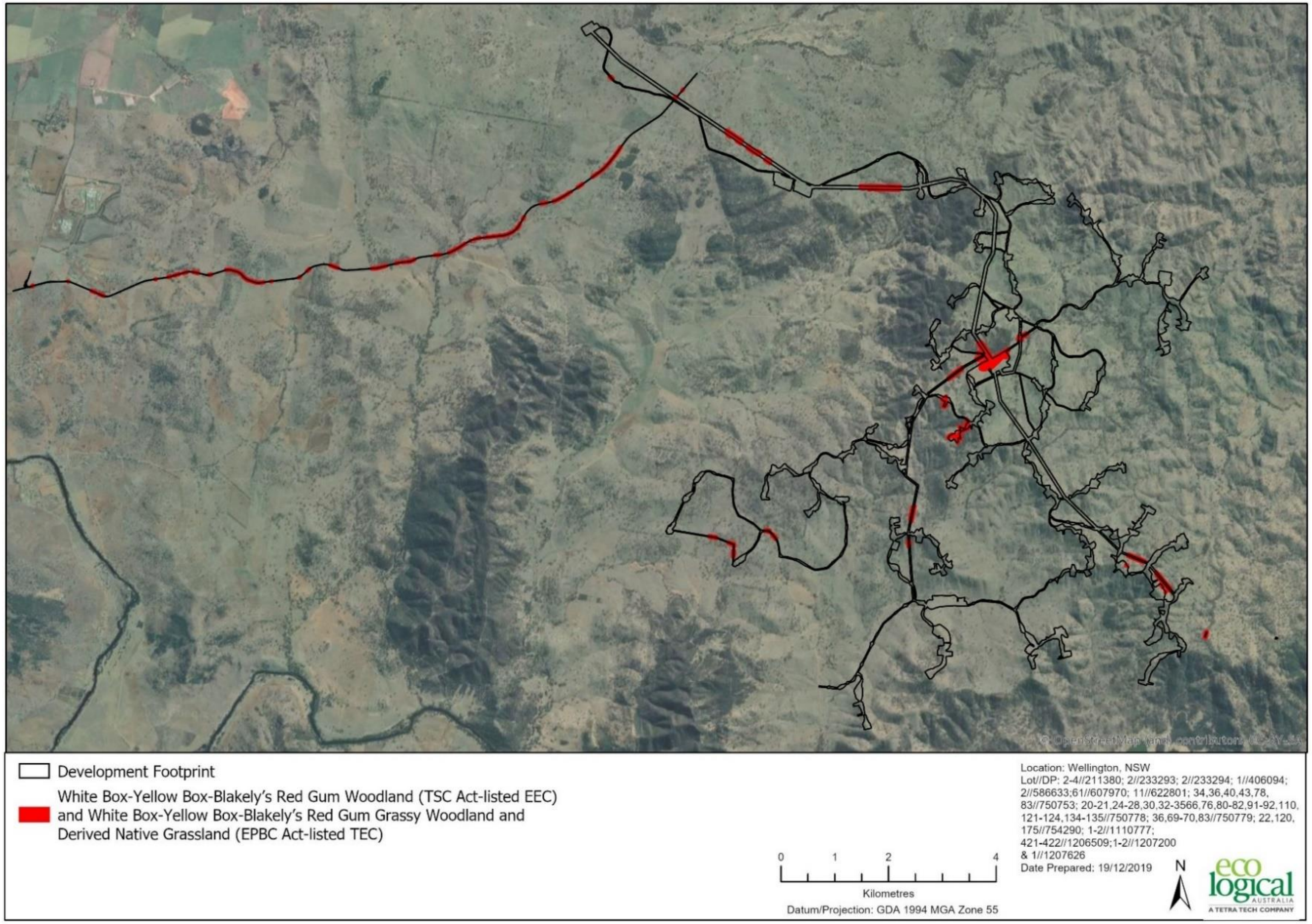


Figure 8-15: Threatened Ecological Communities

8.4.5.3 Threatened Species and Populations

A number of threatened fauna species were recorded by ERM from the surveys; however, most were ecosystem credit species for the FBA, detailed further below. Only one candidate species credit species was recorded in the Study Area, although not within the current Development Corridor:

- *Petaurus norfolcensis* (Squirrel Glider).

Species credit species are detailed further below.

No threatened flora species have been recorded within the Study Area. Threatened flora and fauna records for the current Development Footprint and 10 km buffer, including ERM recorded species, are shown in Figure 8-16 and Figure 8-17 respectively.

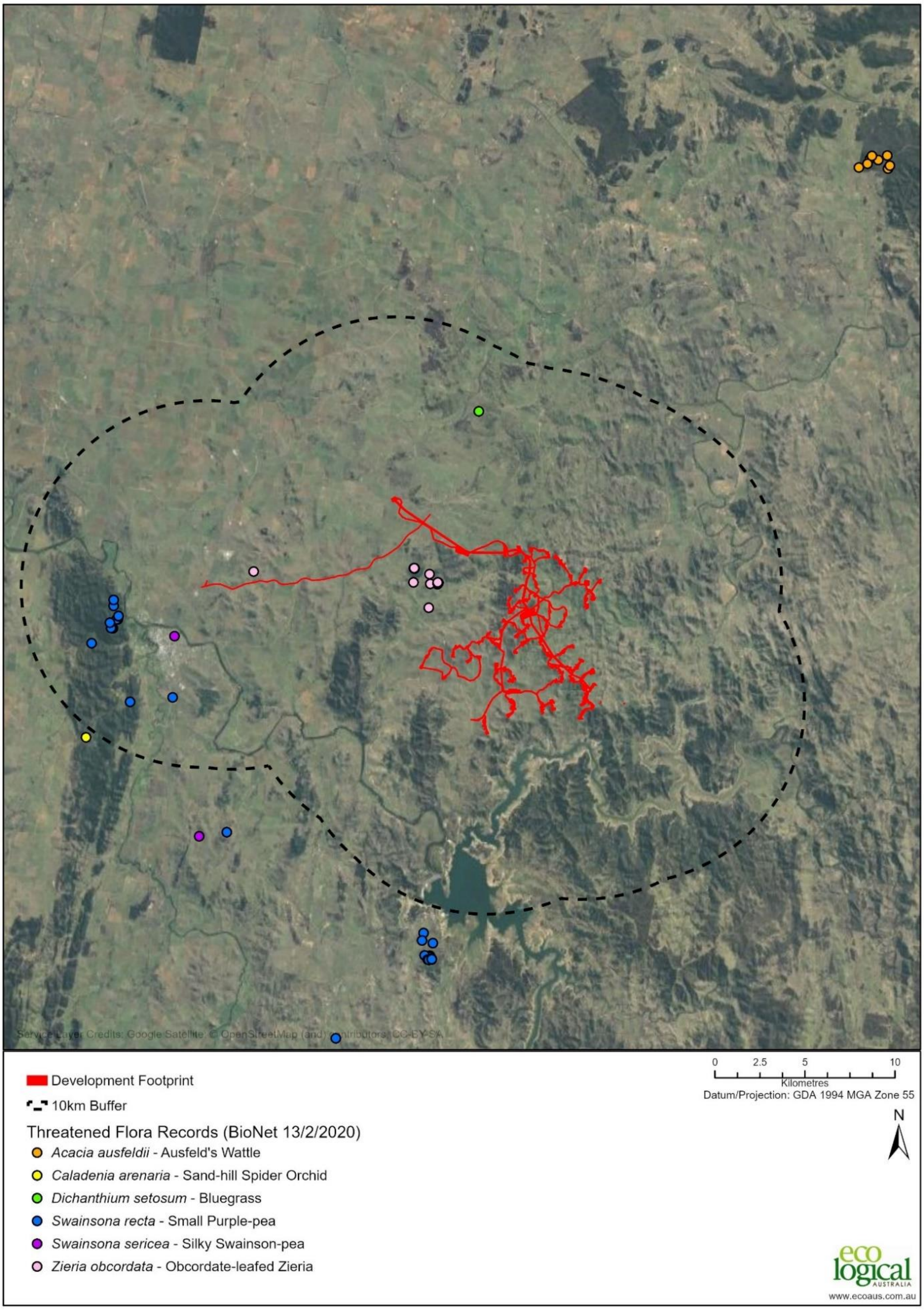


Figure 8-16: Threatened flora records

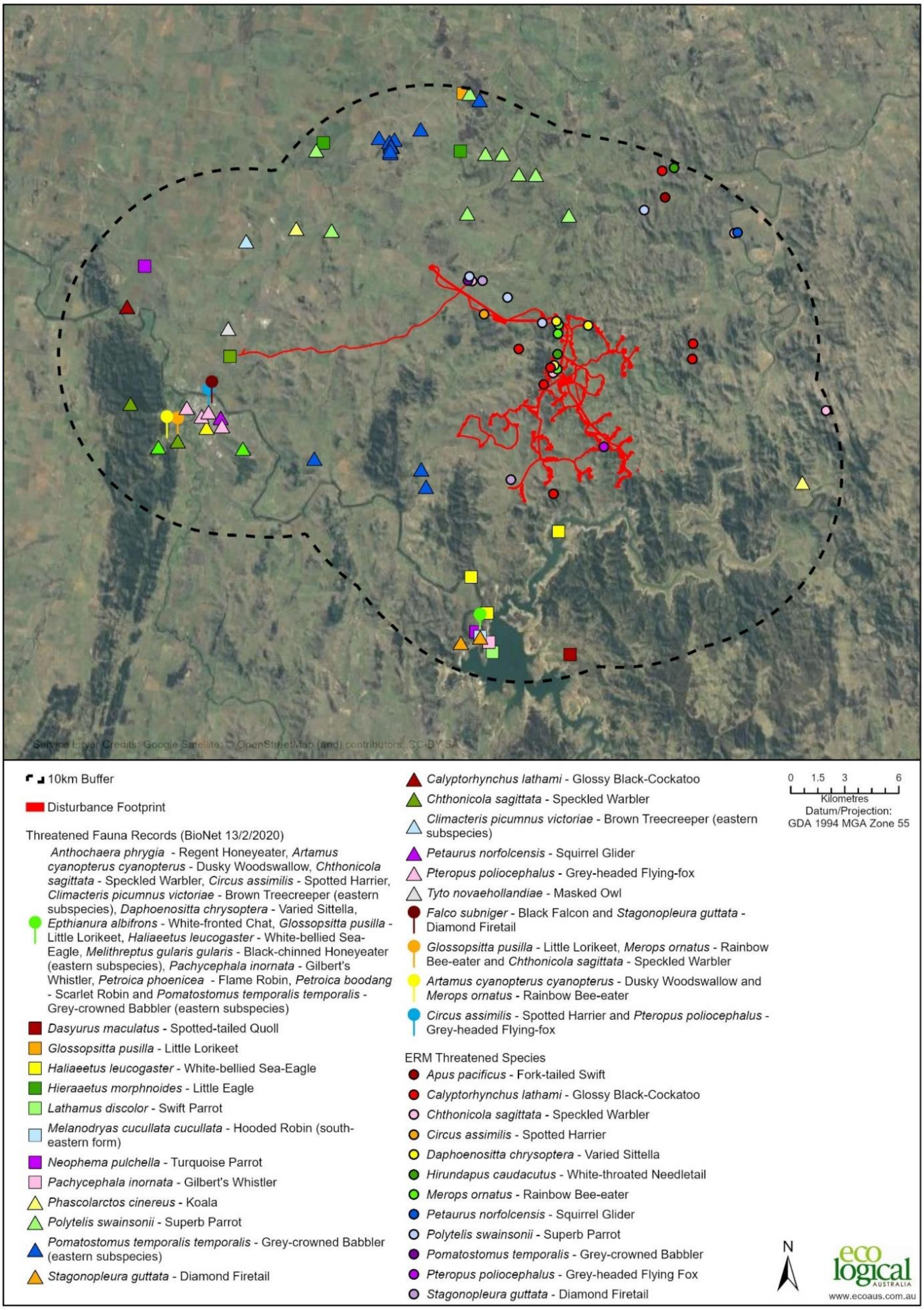


Figure 8-17: Threatened fauna records

Ecosystem Credit Species

The vegetation zones were entered into the BBCC to generate a list of predicted ecosystem credit species. A complete list of all predicted ecosystem credit species is shown in Table 8-17 below. No further assessment of these species was undertaken as any potential impacts would be accounted for through ecosystem credit offsets.

Table 8-17: Ecosystem credit species

Common Name	Scientific Name
Australian Painted Snipe	*Rostratula australis*
Black-chinned Honeyeater (eastern subspecies)	*Melithreptus gularis* subsp. *gularis*
Brolga	*Grus rubicunda*
Brown Treecreeper (eastern subspecies)	*Climacteris picumnus* subsp. *victoriae*
Bush Stone-curlew	*Burhinus grallarius*
Corben's Long-eared Bat	*Nyctophilus corbeni*
Diamond Firetail	*Stagonopleura guttata*
Flame Robin	*Petroica phoenicea*
Freckled Duck	*Stictonetta naevosa*
Gang-gang Cockatoo	*Callocephalon fimbriatum*
Gilbert's Whistler	*Pachycephala inornata*
Glossy Black-Cockatoo	*Calyptorhynchus lathami*
Grey-crowned Babbler (eastern subspecies)	*Pomatostomus temporalis* subsp. *temporalis*
Hooded Robin (south-eastern form)	*Melanodryas cucullata* subsp. *cucullata*
Little Eagle	*Hieraaetus morphnoides*
Little Lorikeet	*Glossopsitta pusilla*
Little Pied Bat	*Chalinolobus picatus*
Little Whip Snake	*Suta flagellum*
Magpie Goose	*Anseranas semipalmata*
Major Mitchell's Cockatoo	*Lophochroa leadbeateri*
Masked Owl	*Tyto novaehollandiae*
New Holland Mouse	*Pseudomys novaehollandiae*
Painted Honeyeater	*Grantiella picta*
Powerful Owl	*Ninox strenua*
Scarlet Robin	*Petroica boodang*
Speckled Warbler	*Chthonicola sagittata*
Spotted Harrier	*Circus assimilis*
Spotted-tailed Quoll	*Dasyurus maculatus*
Square-tailed Kite	*Lophoictinia isura*

Common Name	Scientific Name
Swift Parrot	*Lathamus discolor*
Turquoise Parrot	*Neophema pulchella*
Varied Sittella	*Daphoenositta chrysoptera*
Yellow-bellied Sheathtail-bat	*Saccolaimus flaviventris*

Two further threatened species have been identified within the Study Area, but are not included in the list above:

- *Pteropus poliocephalus* (Grey-headed Flying-fox) – identified from a single carcass caught in barbed-wire fencing (ERM 2013); and
- *Polytelis swainsonii* (Superb Parrot) – identified on the site by ERM in the 2012 – 2013 surveys, and again opportunistically by ELA when undertaken vegetation mapping surveys of Twelve Mile Road in 2019.

Both of these species are ecosystem credit species for BVTs identified in the Development Corridor and no further assessment is required.

Species Credit Species

Species credit species are threatened flora and fauna species that cannot be predicted by vegetation type. Candidate species credit species with the potential to occur within the Development Footprint, based on the presence of suitable habitat, must be surveyed to determine presence or absence.

The list of candidate species credit species for the Development Footprint was generated by the BBCC and is listed in Table 8-18 below. Candidate species credit species have been reviewed in consideration of the ERM assessment, updated NSW BioNet Atlas records and EPBC Protected Matters Search Tool results.

Table 8-18: Species credit species

Common name	Scientific name	Habitat potential	ERM Survey effort (2012 – 2013)	Likelihood of occurrence
Ausfeld's Wattle	*Acacia ausfeldii*	Y	Total of 76.1km of meander transects undertaken for 67 meander transects.	Potential – 12 records within 20km of the Study Area (BioNet 2020a)
Booroolong Frog	*Litoria booroolongensis*	N – no permanent watercourses to be affected by the Project	None undertaken.	Unlikely
Brush-tailed Phascogale	*Phascogale tapoatafa*	Y	25 camera traps deployed for 70 hours each. 21 within woodland or forested areas, four within pasture with scattered trees. Spotlighting surveys conducted over nine nights (35 person hours).	Unlikely – no records within 20km radius of the Study Area, not identified in survey
Brush-tailed Rock-wallaby	*Petrogale penicillata*	Y	25 camera traps deployed for 70 hours each. 21 within woodland or forested areas, four within pasture with scattered trees. Spotlighting surveys conducted over nine nights (35 person hours).	Potential – habitat present, nearest record 15km from Study Area

Common name	Scientific name	Habitat potential	ERM Survey effort (2012 – 2013)	Likelihood of occurrence
Capertee Stringybark	*Eucalyptus cannonii*	N	Total of 76.1km of meander transects undertaken for 67 meander transects.	Unlikely – beyond extent of range of this species
Clandulla Geebung	*Persoonia marginata*	Y	Total of 76.1km of meander transects undertaken for 67 meander transects.	Unlikely – no records within 20km radius of the Study Area, not identified in survey
Eastern Pygmy-possum	*Cercartetus nanus*	Y	25 camera traps deployed for 70 hours each. 21 within woodland or forested areas, four within pasture with scattered trees. Spotlighting surveys conducted over nine nights (35 person hours).	Potential, although no records within 20km of the site
Eucalyptus alligatrix* subsp. *alligatrix	*Eucalyptus alligatrix* subsp. *alligatrix*	N	Total of 76.1km of meander transects undertaken for 67 meander transects.	Unlikely – beyond extent of range of this species
Euphrasia arguta	*Euphrasia arguta*	N	Total of 76.1km of meander transects undertaken for 67 meander transects.	Unlikely – beyond extent of range of this species
Grevillea divaricata	*Grevillea divaricata*	N	Total of 76.1 km of meander transects undertaken for 67 meander transects.	Unlikely – not recorded within 20km of the Study Area, few records exist.

Common name	Scientific name	Habitat potential	ERM Survey effort (2012 – 2013)	Likelihood of occurrence
Koala	*Phascolarctos cinereus*	Y	Spotlighting surveys conducted over nine nights (35 person hours). Koala scat searches conducted around 82 trees in three separate areas. Radius of one metre around base of tree searched by two ecologists until scat found or two minutes was reached.	Likely to occur in the Study Area, albeit in low numbers. Nearest record 7.6 km from the Study Area.
Large-eared Pied Bat	*Chalinolobus dwyeri*	Foraging. No potential breeding habitat to be affected.	85 songmeter nights across study area. Two nights each of two mine adit entrance watching, songmeter placement and harp trapping.	Likely – potential calls from this species identified from songmeter recordings.
Narrow Goodenia	*Goodenia macbarronii*	N	Total of 76.1 km of meander transects undertaken for 67 meander transects.	Unlikely
Pink-tailed Legless Lizard	*Aprasia parapulchella*	Y	Four days of reptile surveys. Surveys included turning of logs, rocks and other ground debris.	Unlikely – not recorded within 20km of the Study Area, few records exist.

Common name	Scientific name	Habitat potential	ERM Survey effort (2012 – 2013)	Likelihood of occurrence
Prasophyllum* sp. *Wybong	*Prasophyllum sp. Wybong*	Y	Total of 76.1 km of meander transects undertaken for 67 meander transects.	Unlikely – not recorded within 20km of the Study Area, few records exist.
Regent Honeyeater	*Anthochaera phrygia*	Y	24 woodland bird surveys, 20-minute searches of 2 ha areas during spring and summer.	Potential
Scant Pomaderris	*Pomaderris queenslandica*	Y	Total of 76.1 km of meander transects undertaken for 67 meander transects.	Unlikely – not recorded within 20km of the Study Area.
Silky Swainson-pea	*Swainsona sericea*	Y	Total of 76.1 km of meander transects undertaken for 67 meander transects.	Potential – records nearby
Small Purple-pea	*Swainsona recta*	Y	Total of 76.1 km of meander transects undertaken for 67 meander transects.	Potential – records nearby
Squirrel Glider	*Petaurus norfolcensis*	Y	25 camera traps deployed for 70 hours each. 21 within woodland or forested areas, four within pasture with scattered trees. Spotlighting surveys conducted over nine nights (35 person hours).	Known – recorded in the Study Area by ERM, albeit not within the current Development Footprint.

Two further potential species credit species were identified for the Development Footprint from the database searches, detailed below in Table 8-19.

Table 8-19: Additional potential species credit species

Common name	Scientific name	Habitat potential	Likelihood of occurrence	Further Assessment Required?
Bluegrass	Dichanthium setosum	Y	Potential – records nearby	Yes – pre-clearing survey and avoidance required during micro-siting of infrastructure
Sand-hill Spider Orchid	Caladenia arenaria	N - requires sandy soils dominated by Callitris glaucophylla (White Cypress Pine)	Unlikely	No – notwithstanding, pre-clearing survey and avoidance will be undertaken during micro-siting of infrastructure

8.4.5.4 Priority Weeds

The field survey undertaken by ERM in 2012 and 2013 identified five priority weeds listed under Appendix 1 of the Central West RSWMP, including *Hypericum perforatum* (St Johns Wort), *Opuntia* sp. (Prickly Pear), *Orobanche* sp (Broomrape), *Rubus fruticosus* spp. agg (Blackberry) and *Xanthium spinosum* (Bathurst Burr).

8.4.6 Potential Impacts

8.4.6.1 Avoidance of Impacts

Under the FBA, the Proponent must design the Project to minimise impacts to biodiversity. Specifically, the FBA requires proponents to identify and avoid direct impacts to:

- Threatened Ecological Communities;
- BVTs/PCTs that contain threatened species habitat;
- Threatened species that cannot be predicted by vegetation type;
- Declared critical habitat; and
- Regional and state significant biodiversity links.

The Development Footprint has been subject to considerable revision and reduction since it was first conceptualised and is currently approximately one third the size of the original Project design. The area of native vegetation to be impacted has reduced from 1,880 ha to 639 ha under the current

Development Footprint. Consideration of biodiversity constraints has, and will continue, to provide significant input into the final Development Footprint.

A summary of the impact avoidance methods of the Proposed Development are provided below (Table 8-20).

Table 8-20: Avoidance of Direct Impacts

Direct Impact to be Avoided	Method to Avoid Impact
Impacts to EECs and CEECs	The Development Footprint has been revised and reduced from the original design, taking into consideration the mapped areas of EEC/CEEC. This has included removing the eastern extent of the Development Footprint and revising the Development Footprint so that minimal EEC is affected. Detailed ecological surveys will be undertaken pre-construction to further assess and delineate areas of EEC/CEEC. Further refinements will be made to the Development Footprint pre-construction which will aim to avoid and minimise clearing of native vegetation, EEC/CEEC. The area of TEC to be impacted may increase or decrease dependent on the detailed design and refinement of vegetation mapping. The significance of impact to any increases in the area of TECs to be cleared will be assessed and where a significant impact is determined, further assessment may be required.
Impacts to vegetation that contains threatened species habitat	Vegetation mapped within the Study Area has been identified as potential habitat for threatened species as identified in earlier sections of this Section. The Development Footprint has been revised and reduced from the original design, to reduce the area of affected vegetation communities that contain threatened species habitat. Infrastructure will be micro-sited prior to construction. This will involve detailed ecological pre-clearing survey to ensure native vegetation clearing is minimised and avoidance of habitat features is prioritised.
Impacts to areas that contain habitat for Vulnerable, Endangered, or Critically Endangered threatened species or populations in accordance with Step 5 in Section 6.5 of the FBA	The Development Footprint provides potential habitat for threatened species. The revision and reduction in size of the Development Footprint has reduced the amount of habitat affected. Infrastructure will be micro-sited prior to construction. This will involve detailed ecological survey to ensure disturbance to threatened species habitat, for example, hollow bearing trees, is minimised and habitat is avoided.

Direct Impact to be Avoided	Method to Avoid Impact
	Further, any threatened flora species identified in the pre-clearing surveys will be avoided through detailed design.
Impacts to areas of land that the Minister for Environment has declared as critical habitat in accordance with s47 of the TSC Act	Critical habitat has not been identified within the Development Corridor.
Impacts to riparian areas of 4th order or higher streams and rivers, important wetlands and estuaries	The Development Footprint includes two 4th order ephemeral streams – Uungula Creek, and Ilgingery Creek. Due to historic agricultural practices and absence of riparian vegetation, the creeks are incised and channel banks show evidence of exacerbated erosion. Further impacts from the Project are considered unlikely, however, a range of mitigation measures will be implemented to avoid impacts and improve biodiversity outcomes. These include: • Establishing vegetated riparian zones. • Construction of additional watercourse crossings in areas where watercourses are not meandering, for example on straight sections of channels. • Minimisation of creek crossings for within site access and electrical cabling. • Localised scour protection around building pads. • Sourcing of water from licensed suppliers.
Impacts to state significant biodiversity links	No state significant biodiversity links have been identified within the Development Footprint.

Site selection was undertaken considering the extent of known biodiversity values within the Development Footprint. A summary of considerations during the selection of the Infrastructure Footprint is shown in Table 8-21.

Table 8-21: Avoidance and minimisation of direct impacts through site selection

Site selection criteria	Method to avoid impact
Selecting a suitable development site for a Major Project or a route for linear projects, should be informed by knowledge of biodiversity values. An	The Project Site is located in an area which has been subject to considerable past disturbance through agricultural clearing. Remnant vegetation is generally

Site selection criteria	Method to avoid impact
initial desktop assessment of biodiversity values would assist in identifying areas of native vegetation cover, EECs or CEECs, and potential habitat for threatened species	degraded and connectivity with surrounding high value vegetation is limited. The Development Footprint has been subject to comprehensive biodiversity assessment to inform the current Development Footprint. These assessments are detailed in earlier sections of this report and include, primarily, the assessment completed by ERM in 2013. Consideration of biodiversity constraints has, and will continue, to provide significant input into the final Development Footprint.
Stage 1 of the FBA will provide the preliminary information necessary to inform project planning. Early consideration of biodiversity values is recommended in site selection, or route selection for linear projects, and the planning phase.	Biodiversity values were identified within the Development Footprint through the assessment process described above. Continued consultation has been undertaken between ELA and CWPR through the development of this BAR to identify any further areas for refinement. Consideration of biodiversity constraints has, and will continue, to provide significant input into the final Development Footprint.
The site/route selection process should include consideration and analysis of the biodiversity constraints of the site and consider the suitability of the Major Project based on the types of biodiversity values present on the site	As identified above, the biodiversity assessment stage was conducted to determine areas of biodiversity constraints. The final Development Footprint will reflect the retention, where possible, of existing biodiversity values within the Development Footprint.
When considering and analysing the biodiversity constraints for the purpose of selecting a site, the following matters should be addressed: *(a) whether there are alternative sites within the property on which the Proposed Development is located where siting the proposed Major Project would avoid and minimise impacts on biodiversity values* *(b) how the development site can be selected to avoid and minimise impacts on biodiversity values as far as practicable*	The Development Footprint will be further refined and reduced as far as practicable and has already included removal of roughly two thirds of the Study Area to avoid biodiversity constraints.

Site selection criteria	Method to avoid impact
(c) whether an alternative development site to the site, which would avoid adversely impacting on biodiversity values, might be feasible.	
For linear projects, the route selection process must include consideration and an analysis of the biodiversity constraints of the various route options. In selecting a preferred option, loss of biodiversity values must be weighed up and justified against social and economic costs and benefits.	This project is not considered a linear project as per the definition in the FBA. A site-based assessment was chosen as the most suitable assessment method given the overall connected shape of the Development Footprint.

Planning was considered during the selection of the Development Footprint. A summary of criteria utilised is shown in Table 8-22.

Table 8-22: Avoidance and Minimisation of Direct Impacts through Planning

Planning criteria	Method to avoid impact
Siting of the Proposed Development – the Major Project should be located in areas where the native vegetation or threatened species habitat is in the poorest condition (i.e. areas that have a lower site value score) or which avoid an EEC or CEEC	The Development Footprint has been subject to comprehensive biodiversity assessment to inform the current Development Footprint. These assessments are detailed in earlier sections of this report and included a desktop review of databases and existing information, vegetation validation, full floristic surveys, habitat mapping and threatened fauna surveys. Consideration of biodiversity constraints has, and will continue, to provide significant input into the final Development Footprint.
Minimise the amount of clearing or habitat loss – the Major Project (and associated construction infrastructure) should be located in areas that do not have native vegetation, or in areas that require the least amount of vegetation to be cleared (i.e. the development footprint is minimised, and/or in areas where other impacts to biodiversity will be the lowest	There are no potential alternative locations, rather, the Development Footprint has been revised and will be reduced as far as practicable in consideration of biodiversity constraints.

Planning criteria	Method to avoid impact
Loss of connectivity – some developments can impact on the connectivity and movement of species through areas of adjacent habitat. Minimisation measures may include providing structures that allow movement of species across barriers or hostile gaps	The Development Footprint generally follows ridgelines and will not impact connectivity between the more vegetated valleys. Riparian vegetation is lacking or degraded within the Development Footprint and will not be subject to any further disconnection. Establishment of vegetated riparian zones will enhance connectivity in the Development Footprint.

8.4.6.2 Residual Impact and Offset Summary

The Project will unavoidably impact approximately 639 ha of native vegetation within the Development Corridor based on the current Development Footprint, which includes vegetation communities listed under the BC Act and EPBC Act (note that the Development Footprint used in this BAR includes the area of clearing required for the External Road Upgrades along Twelve Mile Road between Goolma Road in the west and the Primary Project Site Entry).

The results of the BAR, including the vegetation and threatened species assessment results, were entered into the BBCC. The Development Footprint described in this assessment is indicative only and subject to a detailed design process. It is expected that the offset requirement will be reduced once the final Development Footprint is determined. The Proponent requests flexibility within pending consent conditions that the timing of determining final offset requirements and offsets is cognisant of the detailed design process.

Ecosystem Credit Requirement

Table 8-23 presents the ecosystem credit requirement for the Project based on the current Development Footprint. The full BBCC reports are included in the BARBOS in Appendix G.

Table 8-23: Project ecosystem offset requirements

Vegetation zone	BVT	BVT Description	Condition	Approx. Area (ha)	Credits
1	CW112	Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion	Moderate/Good _Medium	3.57	229
2	CW112	Blakely's Red Gum - Yellow Box grassy woodland of the NSW South Western Slopes Bioregion	Moderate/Good _Poor	64.72	3,530

Vegetation zone	BVT	BVT Description	Condition	Approx. Area (ha)	Credits
3	CW177	Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion	Moderate/Good _Medium	18.69	951
4	CW177	Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion	Moderate/Good _Poor	26	1,099
5	CW177	Red Stringybark woodland of the dry slopes of the South Western Slopes Bioregion	Moderate/Good _Other	7.21	260
6	CW202	Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland of hills of the South Western Slopes	Moderate/Good _Medium	16.66	1,017
7	CW202	Tumbledown Red Gum - Black Cypress Pine - Red Box low woodland of hills of the South Western Slopes	Moderate/Good _Poor	11.27	487
8	CW211	White Box - Rough-barked Apple alluvial woodland on the NSW western slopes	Moderate/Good _Medium	7.68	438
9	CW211	White Box - Rough-barked Apple alluvial woodland on the NSW western slopes	Moderate/Good _Poor	48.55	1,993
10	CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes	Moderate/Good _Medium	13.05	592
11	CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes	Moderate/Good _Poor	310.35	13,158
12	CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes	Moderate/Good _Other	72.83	2,822
13	CW212	White Box - Tumbledown Gum woodland on fine-grained sediments on the NSW central western slopes	Low	38.31	412
			TOTAL	**639**	**26,988**

Species Credit Requirement

Species credits calculated for Koala and Squirrel Glider based on the current Development Footprint are presented below in Table 8-24. Poor and low condition vegetation zones are unlikely to provide habitat and have been excluded from the calculations.

Table 8-24: Project Species Credit Offset Requirement

Scientific name	Common name	Area (ha) habitat loss	Credits
Phascolarctos cinereus	Koala	139.69	3,632
Petaurus norfolcensis	Squirrel Glider	139.69	3,073

Further assessment may be required to exclude the following species:

- Brush-tailed Rock-wallaby;
- Eastern Pygmy-possum; and
- Regent Honeyeater.

These species were not recorded within the Study Area during the ERM in 2012 – 2013 targeted surveys. It is further noted that only Regent Honeyeater is known from nearby records in the region. Further assessment for these species will be undertaken, or expert report prepared, once the Development Footprint has been finalised and areas of suitable habitat to be affected by the Project can be definitively identified.

No threatened flora species have been recorded within the Study Area from or since the ERM surveys which were undertaken in accordance with the 2011 DGRs. Five (5) threatened flora candidate species were identified as having the potential to occur in the Development Footprint based on the associated BVTs, presence of suitable habitat and nearby previous records:

- *Acacia ausfeldii* (Ausfeld’s wattle);
- *Dichanthium setosum* (Bluegrass);
- *Swainsona sericea* (Silky Swainson-pea);
- *Swainsona recta* (Small Purple-pea); and
- *Zieria obcordata.*

Whilst none of the above flora species have been recorded in the Study Area, The Proponent will commit to undertaking pre-clearing surveys in areas of suitable habitat prior to vegetation clearing and micro-siting of infrastructure will be employed to avoid any impact to previously unrecorded threatened flora species.

8.4.6.3 Offset Strategy

The proposed offset strategy for the Project is to acquire and retire all ecosystem and species credits, based on the impacts of the final Development Footprint, once available, to be calculated using the BBCC. It is noted that if no FBA credits are available as matching credits in the market, credits calculated by the BBCC following assessment under the FBA will require determination of reasonable equivalent credits as determined by the current Biodiversity Offset Scheme under the BC Act, determined by the BAM.

The Proponent is considering the BOS for the Project and the final BOS to be delivered for the Project will include one of the following offsetting options under the FBA:

- Securing land (land-based offset);
- Securing required credits through the open credit market; and/or
- Payments to the Biodiversity Conservation Fund (established under the BC Act). One of the key functions of the NSW BCT) is to secure land-based offsets on behalf of developers who pay into the Biodiversity Conservation Fund (BCT, 2018). Through this process the BCT is able to combine offset obligations and funds to establish strategic, larger and more viable offset sites in NSW (NSW Government, 2018).

The Proponent requests flexibility within pending consent conditions that the timing of determining final offset requirements and offsets is cognisant of the detailed design process.

Land-based Offsets

The mechanism to secure land-based offsets is a practical solution that provides security for the proposed offset, but also allows sufficient flexibility for a portion of land to be managed appropriately. Such mechanisms include a stewardship agreement under the BC Act.

CWPR has commenced consultation with surrounding landowners to investigate the options for establishing land-based offsets on neighbouring properties. Preliminary assessments have been undertaken on three properties which has included desktop review of publicly available vegetation community mapping and entry into the BAM Calculator (BAMC). The preliminary assessments have shown that the vegetation communities on neighbouring properties are largely consistent with those in the Development Footprint, including vegetation communities associated with the Box Gum Woodland EEC / CEEC.

Further investigation is required to refine and validate vegetation mapping to determine the offset potential, however, the presence and area (ha) of equivalent vegetation communities indicates that land-based offsets will provide are a viable mechanism to secure and retire the required biodiversity offset credits.

The final offset strategy, including the mechanism to provide for the long-term security of the offset area will be discussed and agreed upon between DPIE and the Proponent.

Once a suitable offset has been identified the following will be provided to DPIE:

- Description of the proposed offset property;
- The mechanism proposed to secure the offset for biodiversity outcomes;
- Ecosystem credit summary;
- Species credits; and
- Management actions to improve biodiversity values.

Management actions would be implemented to manage native vegetation in the offset following approval of the Project. These include:

- Determining benchmark criteria for native vegetation and habitat condition at the site;
- Enhancing the quality of native vegetation and habitat;
- Restoring native vegetation and habitat through support of natural regeneration, targeted vegetation establishment, and potentially through the introduction of habitat features (fallen logs, tree hollows);
- Land Management issues such as salinity, erosion, weeds and feral pests through targeted management programs;
- Controlling access to the site through installation and maintenance of fencing and gates;
- Bushfire management, including access trails and fire breaks; and
- A comprehensive monitoring program to determine the success of management actions to improve biodiversity values and progress the condition of the native vegetation and habitat towards the benchmark state.

8.4.6.4 Matters of National Environmental Significance

For the purposes of assessment under the EPBC Act, the Commonwealth will accredit the FBA. Written confirmation was received from the (former) Department of Environment and Energy in January 2017 that the impacts of the Project are to be assessed under the accredited NSW process.

Notwithstanding, all protected matters that may be affected by the Project must be identified and the significance of impacts must be assessed. The BAR identifies those threatened species and communities listed under the EPBC Act determined to be known, likely or with the potential to be affected by the Project, and lists those species and communities which will require biodiversity offsets as either ecosystem or species credit species, or for which further assessment is required. Justification is provided where no further assessment is required.

The Protected Matters Search Tool (DAWE, 2020a), along with updated NSW BioNet Atlas records and review of the ERM surveys were considered. Table 8-25 below provides a summary of all EPBC Act listed endangered communities which were identified in the data review; EPBC Act listed threatened species are listed in Table 8-26. Those species and communities warranting further assessment are highlighted and confirmed if they are to be offset under the FBA as either species credit or ecosystem credit species.

Table 8-25: EPBC Act listed endangered communities

Ecological communities			
Name	**Likelihood of occurrence**	**Potential impact**	**Further EPBC Act assessment required**
Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	No – not identified in extensive vegetation mapping of the Study Area	No	No
Natural Temperate Grassland of the South Eastern Highlands	No – not identified in extensive vegetation mapping of the Study Area	No	No
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	Known – this community has been identified and mapped in the Development Corridor.	Approximately 11.25 ha of this community would be removed for the current Development Footprint, although this area would be refined following final design and micro-siting. The	**Yes**

Ecological communities			
Name	**Likelihood of occurrence**	**Potential impact**	**Further EPBC Act assessment required**
		assessment of impacts to the CEEC has been undertaken on an assumption that the area may increase by up to 25%, to 14 ha, under the detailed design.	

Table 8-26: EPBC Act listed threatened species

***Scientific name* (Common name)**	**Likelihood of occurrence**	**Potential impact**	**Further assessment required**
***Anthochaera Phrygia* (Regent Honeyeater)**	Potential	Removal of potential woodland foraging habitat	**Yes**
***Aprasia parapulchella* (Pink-tailed Worm Lizard/Pink-tailed Legless Lizard)**	Potential	Unlikely – no records nearby, not identified in ERM survey	No
***Botaurus poiciloptilus* (Australian Bittern)**	Unlikely	No – requires permanent freshwater wetlands	No
***Calidris ferruginea* (Curlew Sandpiper**	Unlikely	No – requires freshwater wetlands or estuarine habitat	No
***Chalinolobus dwyeri* (Large-eared Pied Bat)**	Potential	Removal of woodland foraging habitat	**Yes**
***Dasyurus maculatus* (Spotted-tail Quoll)**	Unlikely	No -– not identified in extensive survey effort, limited habitat present	No
***Delma impar* (Striped Legless Lizard)**	Potential	Removal of habitat through ground disturbance	**Yes**
***Grantiella picta* (Painted Honeyeater)**	Potential	Removal of woodland foraging habitat	**Yes**
***Hirundapus caudacutus* (White-throated Needletail)**	Known	Removal of woodland foraging habitat	**Yes**
***Lathamus discolour* (Swift Parrot)**	Potential	Removal of woodland foraging habitat	**Yes**

Scientific name (Common name)	Likelihood of occurrence	Potential impact	Further assessment required
Leipoa ocellate **(Mallee Fowl)**	Unlikely	No – suitable woodland habitat not present	No
Litoria booroolongensis **(Booroolong Frog)**	No	No - requires permanent water streams	No
Motacilla flava **(Yellow Wagtail)**	Unlikely	No – requires swamp marsh habitat	No
Myiagra cyanoleuca **(Satin Flycatcher)**	Potential	Migratory species, potential removal of foraging habitat	**Yes**
Numenius madagascariensis **(Eastern Curlew)**	Unlikely	No – requires swamp marsh habitat	No
Nyctophilus corbeni **(Corben's Long Eared Bat)**	Potential	Removal of Woodland habitat	**Yes**
Petrogale penicillate **(Brush-tailed Rock-wallaby)**	Unlikely	No – Required Rocky escarpments, outcrops and cliffs.	No
Phascolarctos cinereus **(Koala)**	Potential	Removal of woodland Habitat	**Yes**
Polytelis swainsonii **(Superb Parrot)**	Known	Has been observed within the Development Footprint	**Yes**
Pseudomys novaehollandiae **(New Holland Mouse)**	Potential	Removal of Woodland Habitat	**Yes**
Pteropus poliocephalus **(Grey-headed Flying-fox)**	Likely	Known Flying Fox camp nearby	**Yes**
Rufous Fantail **(Rhipidura rufifrons)**	Unlikely	No – Mainly inhabits subtropical and temperate rainforests	No
Rostratula australis **(Australian Painted Snipe)**	Unlikely	No – Requires swamps dams and marshy areas	No
Dichanthium setosum **(Bluegrass)**	Unlikely	Removal of cleared woodland and grassland habitat.	**Yes**
Eucalyptus alligatrix **subsp.** ***alligatrix***	Unlikely	No – This species only occurs within one known area located approximately 74 km South east of the Development Footprint.	No
Eucalyptus cannonii **(Capertee Stringybark)**	Unlikely	No – The nearest record is located 30 km south east of the Development footprint	No

Scientific name **(Common name)**	**Likelihood of occurrence**	**Potential impact**	**Further assessment required**
Euphrasia arguta	Unlikely	No – The nearest record is located 60 km south east of the Development footprint	No
Prasophyllum petilum **(Tarengo Leek Orchid)**	Unlikely	No – The nearest record is located 73 km south east of the Development footprint	No
Prasophyllum **sp.** ***Wybong*** **(C.Phelps ORG 5269)**	Unlikely	No – The nearest record is located 140 km East of the Development footprint	No
Persoonia marginata **(Clandulla Geebung)**	Unlikely	No – Nearest known population is located near Clandulla approximately 75 km South East of the Development footprint	No
Swainsona recta **(Small Purple-pea)**	Potential	Removal native grassy understorey habitat	**Yes**
Tylophora linearis	Unlikely	No – The nearest record is located 42 km North west of the Development footprint	No
Zieria obcordata	Potential	Removal native grassy understorey habitat	**Yes**

Further assessment of EPBC Act protected species and communities has been undertaken in accordance with the *Significant Impact Guidelines 1.1 - Matters of National Environmental Significance* (Commonwealth of Australia, 2013) included in Appendix H. It was concluded that no significant impacts will occur to EPBC listed species or communities.

8.4.6.5 Bird and Bat Strike

Operational wind farms pose a potential risk to birds and bats through a number of different scenarios, including:

- Collision - fatalities and injuries can occur through collision with the moving blades (blade strike) or with associated infrastructure, such as powerlines or guy wires;
- Lighting – lighting on WTGs may also pose an increased risk to bats by attracting insects causing bats to forage within proximity to the moving blades, potentially leading to blade strike;

- Turbulence – turbulence created by the rotors may also affect species and result in a low level of mortality. Such impacts are particularly likely for smaller birds and bats, which would be less able to divert course away from the blades or strong turbulence, once caught in the turbulence zone; and
- Barotrauma - death of birds and bats due to pressurised air at the blade tips, is less likely to impact birds due to the rigidity of their lungs, than it is likely to impact upon bats (Baerwald et al, 2008).

There are a number of important factors that influence bird and bat mortality as a result of blade strike, turbulence and barotrauma, with the location of wind farms seen as a major factor, with those sited near wetlands, critical habitat areas, or along migratory flight paths having greatest impacts. The rates of collisions and impacts from turbulence can be influenced by adverse weather conditions and poor visibility, flight characteristics of and an individual species' ecology (e.g. migratory species may be less familiar with the area).

Collision strike has been well studied within Europe and North America for decades, where seasonal migratory birds are common, whereas in Australia, studies are not as well established. In Australia, collision rates are generally around one to two birds per WTG per year (AusWEA 2004).

Within Australia most wind farm development has been along coastal areas in Western Australia, South Australia and Victoria, and tends to focus on impacts to threatened species. In 2005, a report produced for the Department of Environment and Heritage, modelled cumulative impacts of wind farm developments on the Swift Parrot, across its south-eastern Australia range. The modelling provided a measure of potential risk at different rates at which birds might avoid collisions (Smales, 2005). Based upon the modelling, the report concluded that the number of Swift Parrots that might be killed by collision on average per annum at each wind farm, according to three avoidance rates, was cumulatively between 0.08 and 0.13 Swift Parrots per year.

Studies conducted at Stanwell's Toora wind farm in South Gippsland found no evidence of significant levels of bird mortality with any impacts confirmed to localised indirect effects on common farmland birds. Species such as Wedge-tailed Eagles were regularly observed before and after operations began, but avoided the WTGs by flying around or between them (AusWEA 2004).

Data relating to bat collision mortality within Australia is limited. One example of mortality data is that from Woolnorth wind farm, which was published by Hydro-Tasmania, where 1.86 bats per WTG per year have been recorded to be killed by collision. This range is comparable to that recorded for most North American and European wind farms (Brett Lane & Associates, 2011).

As the Australian industry develops, more information is coming to light that the mortality rates at Australian wind farms are lower than in the northern hemisphere, which appears to be due primarily to the lack of large numbers of night-migrating songbirds in Australia (AusWEA 2004).

A collision risk assessment was undertaken on the former, much larger Project layout (Appendix I) to calculate the collision risk for the Project upon birds and bats. The operational parameters considered within the ERM assessment were a maximum chord width of rotor at 2 m, pitch angle of rotor at 24 degrees, rotor diameter at 144 m and rotation period at 4.29 m/s. The assessment utilised the Collision Risk Model developed for Scottish National Heritage and underwent a two staged process. The first stage was to determine the risk (probability) of a bird being hit by a WTG blade when making a transit through a rotor without any avoidance. The probability was determined by the bird length, wingspan, likely travelling speed (Spaar and Bruderer, 1996) and if they are likely to be flapping or soaring.

The collision risk was estimated for identified species recorded during the survey undertaken by ERM in 2012 and 2013 (White-throated Needletail and Wedge-tailed Eagle), and species that are known to fly below the rotor height were not included in the assessment. The predicted collision risk from the Collision Risk Model generated an average collision risk for each subject species of upwind flying direction and downwind flying direction. The second stage was to estimate the number of birds flying through the rotors per month.

The results of the collision risk model indicated that between 1.06 and 0.21 White-throated Needletail's per month may collide with the WTGs, and between 0.20 and 0.04 Wedge-tailed Eagle's per month may collide with the WTGs. This analysis was undertaken over a larger WTG layout and Study Area than the current proposed WTG layout. In consideration of the above modelled results, potential impacts to birds are expected to be relatively minimal and in line with stated AusWEA (2002) and Barclay et al. (2007) collision rates of below one to two birds per WTG per year.

Biodiversity surveys recorded two threatened bat species (Eastern Bentwing Bat and Yellow-bellied Sheathtail-bat) (refer to Appendix I) within the study area which may be susceptible to rotor strike and barotrauma due to their foraging habits and being highly mobile over large areas. The Eastern Bentwing Bat is a cave roosting bat and no maternity sites are located within the study area or immediate locality. Given this, it is expected that this species would likely occur in low densities across the study area and therefore the collision risk, additional lighting on WTGs, turbulence and barotrauma would not a pose a significant threat to this species. The Yellow-bellied Sheathtail-bat forages for insects in a wide variety of habitats across a large range, and flies high and fast over the forest canopy, and lower in more open country (OEH, 2020). It Is unlikely that a significant number of rotor collision or barotrauma deaths will occur as a result of the Project, as the majority of WTG locations are within areas of poor habitat, usually along ridges and in open country.

8.4.6.6 Aquatic Ecology

The Project is not expected to significantly impact on any aquatic ecology due to the absence of permanent streams and waterways within the Development Corridor. Nonetheless, threatened aquatic species and ecological communities with the potential to occur in the area have been identified and the significance of any impacts from the Project have been assessed.

Aquatic ecology with the (limited) potential to occur in the Development Corridor includes:

- Threatened fish
    - *Mogurnda adspersa* (Southern Purple Spotted Gudgeon)
    - *Tandanas tandanus* (Eel-tailed Catfish population of the Murray-Darling Basin)
    - *Ambassis agassizii* (Western population of Olive Perchlet)
- Threatened aquatic ecological communities:
    - Aquatic ecological community in the natural drainage system of the lowland catchment of the Darling River

The assessment of significance of any impacts to aquatic ecology has been undertaken in accordance with Section 220ZZ of the FM Act included in Appendix H. The assessment concluded that the Project will not result in significant impacts to any aquatic ecology, further discussed in Section 8.9 of this EIS.

8.5 Traffic and Transport

Traffic and transport impacts may create a number of direct and indirect adverse effects, including noise and dust generation, traffic delays, impacts to safety and damage to infrastructure. As such, concerns regarding traffic impacts have been identified throughout the community and stakeholder consultation process during the evolution of the Project.

Potential impacts have been considered from port to the Project Site, with the intention of minimising impacts to urban and business areas, residences and other road users.

By nature, road impacts are generally temporal in both space and time, as such particular focus is placed on reducing impacts to sensitive receptors (residences) int her vicinity of the Project Site. Through refinements in Project Design, transport route impacts on closely located residences have been minimised (Table 8-27) through the identification of alternative site access routes located throughout the Project Site.

Table 8-27: Residence impact minimisation changes over time – Transport route passing residences

	2013 249 WTG layout and 200m BTH	2018 127 WTG layout and 200m BTH	2018 125 WTG layout and 250m BTH	2019 117 WTG layout and 250m BTH	2019 109 WTG layout and 250m BTH	2020 97 WTG layout and 250m BTH
Number of Residences	119	112	112	112	13	13

8.5.1 Introduction

The Transport Assessment has been prepared by Samsa Consulting Pty ltd (2020), and has been undertaken in accordance with the requirements of the SEARs, which include:

- assess the construction, operational and decommissioning traffic impacts of the development;
- provide details of traffic volumes (both light and heavy vehicles) and transport routes during construction, operation and decommissioning, including traffic associated with sourcing raw materials (water, sand and gravel);
- assess the potential traffic impacts of the project on road network function (including intersection performance and site access arrangements and road safety, including school bus routes and school zones;

- assess the capacity of the existing road network to accommodate the type and volume of traffic generated by the project (including over-mass / over-dimensional traffic haulage routes from port) during construction, operation and decommissioning;
- an assessment of the likely transport impacts to the site access and haulage routes, site access point, any rail safety issues, any Crown land, particularly in relation to the capacity and conditions of the roads;
- provide details of measures to mitigate and / or manage potential impacts including a schedule of all required road upgrades (including resulting from over mass / over dimensional traffic haulage routes), road maintenance contributions, and any other traffic control measures, developed in consultation with the relevant road authority.

A full copy of the Transport Assessment is provided in Appendix L. The Transport Assessment outlines a strategy for the most effective, safe and least imposing methods for delivery of plant and equipment to the Project Site. This section provides a technical review of any potential transport and traffic implications arising from the Project, including the potential impacts associated with decommissioning activities; however, these have not been prepared in detail as future traffic volumes and road conditions cannot be accurately determined or assessed at this stage.

The transport comprises a desktop study, consultation and fieldwork. The desktop study involved reviewing maps of the Project area to identify key features of the surrounding road network and revision of Transport for NSW data to establish existing traffic volumes along each road. Consultation has been undertaken by Samsa Consulting with the Proponent, Transport for NSW, Dubbo Regional Council and transport companies that typically undertake heavy vehicle transport. The scope of the transport aspects investigated as part of the Transport Assessment included:

- Likely traffic generation and impacts;
- Access arrangements for staff and deliveries;
- Identification of any roads or intersections which need to be upgraded, in addition to mitigations for pavement impacts;
- Assessment of the outcomes of the Route Study (RJA, 2020; Appendix M); and
- Traffic Impact Assessment.

Due to the size and weight of the WTG components, it is expected that many of the delivery vehicles will be OSOM. These types of vehicles will require National Heavy Vehicle Regulator and Transport for NSW operating permits to allow them to travel on public roads. Consultation with RMS and specialist traffic consultants provided Project information, advice on existing traffic conditions and preferred routes for OSOM vehicles to the Site. At the time of the assessment, there were no relevant Council traffic or road policies identified that would impact the Project. Site visits to the Project Site and surrounding road network have been undertaken to determine the preferred route and identify the potential traffic impacts on the road network, including the provision of site access, road safety, road capacity and existing conditions.

The objectives of the technical reports, in part, were to develop strategies and recommendations to minimise traffic impacts throughout the life of the Project with the focus being on the construction phase, as this is likely to generate greater traffic impacts compared to the operational and decommissioning phases. Samsa Consulting has considered all potential site access locations and transport route options from various directions. The preferred transport route was chosen as it has the lowest practicable impact to the existing road network and road users, however many elements were taken into consideration during the assessment process, including:

- Standard of road infrastructure, including pavement type and condition, width of carriageway and road formations, pavement line marking, controlled access to side roads, and bridge and culvert crossings;
- Speed limit and school zones;
- Restrictions on vehicle access as prescribed by road authorities and physical obstructions such as overhead powerlines, overpasses, crests, dips and tight radius curves;
- Road user conflicts such as traffic volumes and local, regional and school bus routes;
- Distance from major road networks to the Project Site access points;
- Clearing or pruning of roadside vegetation; and
- Obstacles such as roadside furniture that may need to be removed.

Preliminary upgrade plans for Twelve Mile Road were also prepared (iCubed, 2020) and are provided in Appendix N.

Detailed mitigation and management measures are provided in Appendix L, Appendix M and Appendix N, and are summarised in Environmental Management (Section 9) as Statement of Commitments TM001, TM002, TM003, TM004 and TM005.

8.5.2 Existing Environment

8.5.2.1 Transport Routes

The Project Site is located approximately 14 km East of Wellington in NSW and is approximately 400 km by road from the Port of Newcastle. The main commercial centres surrounding the Project Site are the townships of Wellington, Dubbo and Mudgee, each a robust regional centre with many commercial businesses, residences and schools.

In the initial design process, there were several potential transport routes identified, considered and initially reviewed based on their merit and current capabilities. The assessment considered the preferred site access locations and the road transport options available from the most likely port of entry (Newcastle, although other ports may be used if they are commercially viable for the Project which could then link with the studied route). As a result of the findings, Samsa Consulting (2020) propose a preferred route for transport of the WTG infrastructure (including towers, Nacelle, rotor and blades) from the Port of Newcastle, to the site westward via the Pacific Highway, John Renshaw Drive, Hunter Expressway, New England Highway, Golden Highway, Saxa Road, Mitchell Highway and eastbound along Goolma Road to Twelve Mile Road. The Route Study (RJA, 2020) provides a detailed description of the preferred transport route for WTGs from the Port of Newcastle to the primary site access along Twelve Mile Road (Appendix M).

It is proposed to construct a new primary access off Twelve Mile Road, approximately 17 km east of Wellington by road which will be used for all OSOM deliveries to the Project Site and the main access point for standard Heavy and Light Vehicles. Secondary access points and cross-over locations along Uungula Road and Ilgingery Road will interconnect Internal Roads throughout the Project Site required for construction and operational vehicles (Figure 1-2).

Many of the resource components, including road base and concrete products required during the construction phase of the Project may be sourced from these regional centres and surrounding towns. Therefore, flexibility is required in the Development Consent to preserve the opportunity to source locally any of the above resources and consequently to provide the ability to further define road routes for Heavy and Light Vehicles post consent. A short section of Ilgingery Road will be used during construction and operational activities for OSOM, Heavy and Light Vehicles, which will gain access via the primary Project Site entry and Internal Roads, to access a small number of WTGs at the western edge of the layout. Deliveries of all OSOM components to the site will bypass Dubbo, Wellington and Gulgong CBDs to minimise disturbance to local traffic.

The major road network along the nominated preferred transport route provides a relatively high level of road infrastructure that can accommodate transport by OSOM vehicles. The preferred transport route from the port of entry has relatively wide carriageways and road formations, pavement line marking and controlled access to side roads. Speed limits along the preferred transport route is generally 100 km/h.

The minor road network comprises rural roads that are of lesser standard to the major road network however regularly accommodate heavy farm machinery and are classified B-double routes. Minor roads leading from the Golden Highway to the nominated site access typically have 6 m width, accommodating two lanes and varying shoulder conditions. The asphalt paving is generally in good condition and along the preferred route and there is centreline marking for most of the way. Some minor road upgrades will be required as identified in the Route Study (RJA, 2020). The proposed haulage from the Golden Highway to the Site during construction is: -

- Exiting Golden Highway onto Saxa Road;
- Turning left from Saxa Road onto Mitchell Highway;
- Turning left from Mitchell Highway onto Goolma Road;
- Turning right from Goolma Road onto Twelve Mile Road; and
- Turning right into the site from Twelve Mile Road.

The proposed exit route for the majority of transport vehicles from the Site is the same as the access route, that is:

- Exiting the Site, turning left onto Twelve Mile Road;
- Turning left from Twelve Mile Road onto Goolma Road;
- Turning right from Goolma Road onto Mitchell Highway;
- Turning right from Mitchell Highway on to Saxa Road; and
- Turning right from Saxa Road onto Golden Highway.

The characteristics and classifications of these roads are provided in Table 8-28.

Table 8-28: Road classifications

Road	Speed Limit*	Lanes	Classification	Authority
Golden Highway	100 km/h	2 (divided asphalt road)	National	Transport for NSW
Mitchell Highway	100 km/h	2 (divided, asphalt road, 7 -8 m wide)	State	Transport for NSW

Road	Speed Limit*	Lanes	Classification	Authority
Saxa Road	100 km/h	2 (undivided, asphalt road, 7 -8 m wide)	Rural	Dubbo Regional Council
Goolma Road	100 km/h	2 (undivided, asphalt road, 7 -8 m wide)	Rural	Dubbo Regional Council
Twelve Mile Road	100 km/h	1 (undivided, asphalt road, 5 - 7 m wide)	Rural	Dubbo Regional Council

* The posted speed limit on the Golden Highway, Mitchell Highway and Saxa Road is 100 km/h. The other roads noted above are not sign posted and are therefore assumed to have a rural speed limit of 100 km/h.

** Possible alternate route only

The preferred transport route can effectively provide a single transportation mode from the port to the Project Site without the need for additional loading or handling operations. The major road network provides a high standard of road infrastructure, generally suitable for transport by OSOM vehicles. The proposed minor road network connecting the Golden Highway to the site access, is of lesser standard however is still able to accommodate the proposed increase in traffic for the Project. A detailed summary of the existing conditions and proposed road upgrades for the preferred route is provided in sections 10 and 12 of Route Study (RJA, 2020); Appendix M). Also, further detail on the level and extent of road upgrades is provided in sections 5.3 and 5.4 of Transport Assessment (Samsa Consulting, 2020; Appendix L). A preliminary design of the required road upgrades to Twelve Mile Road between Goolma Road and the primary Project access point is provided in the design drawing set at Appendix N. Where OSOM vehicles are required to use minor road networks, including regional and rural roads, upgrade works, and mitigation measures will be implemented in consultation with Dubbo Regional Council and Transport for NSW.

8.5.2.2 Traffic Volumes

Traffic volume information has been obtained from available RMS and Council information for the various sections of road. The assessment of traffic volumes from the State road network (Golden Highway) has allowed for a conservative or high traffic growth rate and the worst-case scenario (highest traffic volumes) was adopted for the assessment. Current (estimated) traffic volumes in vehicles per day (vpd) and vehicles per hour (vph) for the surrounding road network are shown in Table 8-29.

Table 8-29: Current (Estimated) 2019 Estimated Traffic Volumes

Road	Vehicles Per Day (vpd)	Vehicles Per Hour (vph)	Traffic Volume Source

Golden Highway	2,050	170	RMS traffic data (2019).
Mitchell Highway	2,520	230	RMS traffic data (2019).
Saxa Road (formerly Cobbora Road)	150	<30	Councils' traffic data (October 2013).
Goolma Road (western end)	870	120	Council traffic data (March 2013).
Twelve Mile Road	<100	<20	Council traffic data (January to March 2007) – corroborated by on-site observations and sample counts (2013).

Daily traffic flows (vpd) recorded on the major road networks are well within the capacity of the existing road infrastructure leaving capability to accommodate additional traffic, including OSOM vehicles. Existing traffic volumes in the immediate vicinity of the Site are very low, reflective of the rural environment and are considered negligible in comparison to the major road networks. The local roads are generally utilised by residents to access private property and provide a link to the local community as they are the primary access to surrounding regional centres including Wellington and Dubbo. Twelve Mile Road provides access to several rural land holdings however does not provide a direct access for through traffic movements. Traffic surveys taken during the AM and PM found that the traffic flows on this road are <100 per day.

8.5.3 Potential Impacts

During the various stages of the Project, several tasks would generate traffic. These are categorised as follows:

- Wind farm component delivery;
- Construction material delivery;
- Construction staff transport;
- Operational staff transport;
- Maintenance vehicle transport;
- Decommissioning material removal; and
- Decommissioning staff transport.

Traffic-generating tasks include:

- Initial site set-up and access construction during the pre-construction period;
- Construction staff movements, wind farm component deliveries (including OSOM transport), concrete material deliveries and other general deliveries during construction works;

- Operational staff movements during operation and maintenance; and
- Decommissioning and reinstatement construction activities.

It would also require minor upgrades and repairs to rural roads to accommodate transport of OSOM, to be determined by Dubbo Regional Council and Transport for NSW. The transport of materials and equipment to the Project Site during the construction phase would result in temporary increase in traffic and volume, as well as very short-term road closures and delays to local traffic in the form of stop-go, alternating single directional traffic flows and 'rolling stoppages' as OSOM vehicles pass by other road users. During the operational phase the volume of traffic relative to the construction phase would be comparatively less and only a small number of operations and maintenance vehicles would access the site, as well as the occasional larger vehicle for maintenance of the WTGs and internal road works.

8.5.3.1 Transport Route

Due to various road network and land use constraints, the preferred road transport route for OSOM on approach to the Project Site is via Dunedoo on the Golden Highway, left-turn south onto Saxa Road, left-turn south-east onto Mitchell Highway, left-turn north onto Goolma Road, and then right-turn onto Twelve Mile Road to the primary Project Site access location. Traffic movements associated with the various stages of the Project include transport of the WTG components, concrete / asphalt batch plant material delivery, steel reinforcement and inter WTG cabling deliveries, as well as recurrent transport of workers. Raw materials and some construction plant and equipment will be sourced locally and from nearby regional centres with transport along the major road network and standard heavy vehicle road network, or alternatively along routes permitted by the resource supplier's permitting and approvals process.. Light vehicles and buses associated with the workers and contractors are also anticipated to originate from surrounding regional centres such as Dubbo.

Figure 8-18: Location of the proposed primary Project Site entry point on Twelve Mile Road (RJA, 2020)

The Golden Highway and Mitchell Highway have adequate capacity to cater for construction traffic as these roads are key freight routes in NSW and designated OSOM load carrying vehicles network approved roads by Transport for NSW (Figure 8-19). It is considered the proposed additional truck movements associated with transport of the WTGs and other construction activities for the Project will have minimal impact upon road capacity of major state-managed roads.

All local roads along the preferred transport route are approved B double routes (with the exception of Twelve Mile Road) with road pavement and adequate width to cater for passing vehicles. Local roads also have the ability to cater for increased truck movements due to the existing low traffic volumes (<100 per day along Twelve Mile Road). A detailed schedule of the recommended required road works and upgrades along the preferred transport route is provided in section 5.4 of the Transport Assessment (Samsa Consulting, 2020; Appendix L).

The decommissioning haulage route will be determined towards the end of the operational period of the Project, as the existing road infrastructure may have changed of the life of the Project, however as a rule, the decommissioning haulage route will be the same as the construction haulage route.

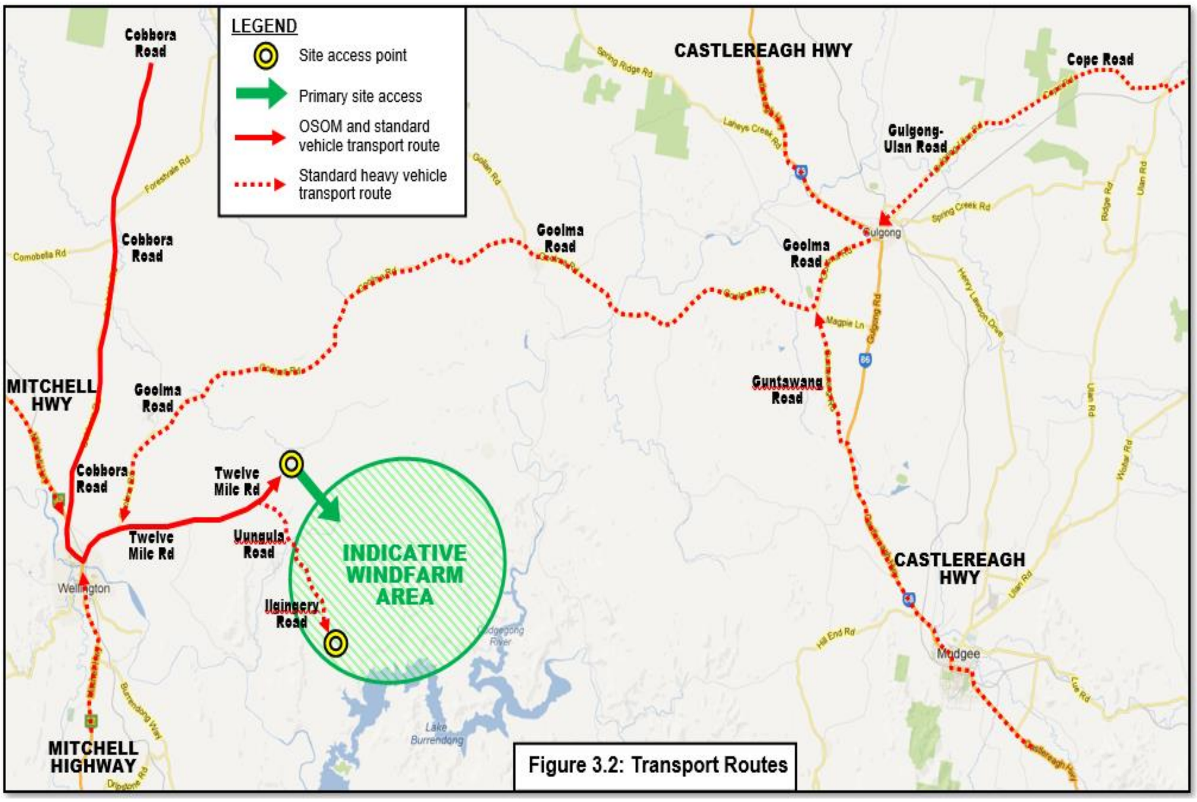


Figure 8-19. Regional road network and proposed construction traffic routes

8.5.3.2 Construction Traffic Generation

Construction and commissioning traffic for the installation of the WTGs would be on-going over a period of approximately 24 to 30 months. Construction transport related activities, including OSOM traffic, would consist of:

- Transport of construction machinery and labour to the Project Site;
- On-site civil works for internal access roads, crane pads, laydown areas, WTG footings and cable trenching;
- Road upgrade works to the public road network to allow OSOM transportation;
- Transport of WTG infrastructure to the Project Site;
- Installation of WTGs on site using cranes;
- Construction of electrical Substations;
- Construction of site control room and operations and maintenance facilities;
- Construction of electrical transmission lines; and
- Restoration and revegetation of disturbed areas.

Each WTG will typically require up to 11 escorted OSOM Vehicles, including three to six for the tower sections, three for the blades, one for the nacelle and one for the hub (depending on the WTG model selected). WTG components will be transported by articulated semi-trailers (extendible and regular trailer sizes), heavy duty low loaders, dolly/jinker arrangements and a variety of high power prime movers – for transporting initial establishment equipment, materials and WTG components.

In terms of each heavy vehicle movement, load weights and lengths of equipment and components will vary. The heaviest loads are expected to be the nacelles (one per WTG) or transformers. OSOM loads will be carried on trailers, or combinations of trailers, with sufficient axle groups to ensure compliance with point load and overall load limits for the particular road surface. OSOM vehicles will be run under escort with limited speed to reduce loading stress on the road surface and minimise potential for damage. The longest required loads will be for the blades, which require trailer lengths up to 82 metres in length. A tabled review of the characteristics of each WTG component and their estimated traffic volumes throughout the construction phase are provided in Table 8-30.

Table 8-30: Summary of project components and indicative traffic generation

Wind Farm Component	Characteristics	Traffic Generation (indicative)
Nacelle	Weight is up to 125 tonnes, one per WTG.	Traffic generation for one WTG: one over-mass vehicle Traffic generation for 97 WTGs: 109 over-mass vehicles
Drivetrain	Weight is up to 60 tonnes, one per WTG	Traffic generation for 1 WTG: 1 over-mass vehicle Traffic generation for 97 WTGs: 97 over-mass vehicles
Blades	Three blades per WTG. Single blade per vehicle.	Traffic generation for one WTG: three over-size (length) vehicles Traffic generation for 97 WTGs: 291 over-size (length) vehicles
Hub	Typical weight is approximately 40 tonnes, one per WTG in single load.	Traffic generation for one WTG: one low-loader vehicle Traffic generation for 97 WTGs: 97 low-loader vehicles
Tower	Typically three to six sections: each weighing between 20 and 65 tonnes depending on the section	Traffic generation for one WTG: five low-loader (over-mass) vehicles

Wind Farm Component	Characteristics	Traffic Generation (indicative)
	and measuring between approximately 15 m to 30 m long.	Traffic generation for 97 WTGs: 485 low-loader (over-mass) vehicles
Additional Materials	Typically for each WTG, additional miscellaneous equipment to be delivered to the site would require approximately one container (semi-trailer) truck.	Traffic generation for one WTG: five semi-trailer truck Traffic generation for 97 WTGs: 97 semi-trailer trucks
Substation Buildings	There would be up to three buildings at each substation location to house switching equipment	Traffic generation: 3 over-mass vehicles
Substation Transformers	The main and secondary collector substation transformers would have a typical weight of over 100 tonnes (although this is dependent on the design). Transportation of transformers would be by road and would involve direct loading onto a platform trailer (assumed seven although this is dependent on network connection design).	Traffic generation: Seven over-mass vehicles + ten semi-trailers of support equipment.
Switching Equipment	Semi-trailer for transportation of switching station components at the point of connection.	Traffic generation: 20 semi-trailers of components and associated equipment.
Overhead Transmission Lines	Semi-trailer for transportation of power poles, conductors, wires and other materials.	Traffic generation: dependant on final details of pole numbers, spacing and location but assume a minimum 20 semi-trailers of poles and associated transmission line equipment.
WTG Erection Cranes	Assume four cranes (two main cranes and two tailing cranes) moving between WTG sites. These would travel to the preferred site access point at the start of construction and then leave at the end.	Traffic generation: four over-mass vehicles + 30 semi-trailers of support equipment.

During the construction period, the largest number of heavy vehicle movements would be for the delivery of concrete batch plant material delivery, as shown in Table 8-31 below. Other non-OSOM heavy vehicles proposed to be used during the construction phase include the following: -

- Tipper trucks – to bring raw materials onsite for internal access roads and hardstand areas;
- Bulldozers and graders for construction of Internal Roads;

- Concrete agitators – to transport concrete from the batching plant for use on-site;
- Water carting and spraying trucks;
- Cranes (various sizes); and
- Conventional 4WD vehicles and buses for transporting staff on-site.

The impacts of road traffic noise and dust generated from additional heavy vehicle movements along the primary haul route would be minimal as these are generally either sealed regional highways (separated from dwellings and businesses) or sealed regional roads that already accommodate for significant daily traffic volumes and classified B-double routes. Internal Roads will be constructed of hardstand gravel surface and may be sealed dependent on the civil design requirements. The unsealed sections of internal road networks may cause dust generation during the peak construction phase, depending on climate conditions at the time. Dust suppression activities will be included in the mitigation measures for the construction and decommissioning phases.

Traffic generation predictions used in the transport assessment by Samsa Consulting ranges from a moderate (average) scenario (that would apply to most of the construction period), to a conservative (high) scenario (which assumes that estimated staff movements coinciding with other peak traffic generating activities, such as delivery of WTG components).

Estimated traffic generation was divided into daily movements (i.e. two-way movements where one vehicle counts in the table as '2') shown as vpd and peak hour trips shown as vph. Traffic generation for worst case scenario, or maximum vehicle movements, is shown in Table 8-31.

Table 8-31: Estimated Project-related construction traffic projections (peak activity or 'conservative' estimates shown in brackets)

Traffic Generating Activity		Mitchell Highway/ Golden Highway	Saxa Road[9]	Goolma Road	Twelve Mile Road
Construction staff	vpd	120 (200)	20 (40)	240 (400)	240 (400)
(Light Vehicles only)	vph	60 (100)	10 (20)	120 (200)	120 (200)
Wind farm component delivery	vpd	0 (10)	0 (10)	0 (10)	0 (10)
(OSOM vehicles)	vph	0 (4)	0 (4)	0 (4)	0 (4)

[9] Apart from the OSOM transport, some nominal staff traffic generation has been assigned along Saxa Road.

Traffic Generating Activity			Mitchell Highway/ Golden Highway	Saxa Road[9]	Goolma Road	Twelve Mile Road
Wind farm component delivery		vpd	0 (6)	0 (6)	0 (6)	**0 (6)**
(non-OSOM heavy vehicles)		vph	0 (2)	0 (2)	0 (2)	**0 (2)**
Concrete batch plant material		vpd	20 (20)	0 (0)	40 (40)	40 (40)
delivery (heavy vehicles)		vph	5 (6)	0 (0)	5 (6)	5 (6)
Delivery of steel reinforcement		vpd	4 (4)	0 (0)	8 (8)	8 (8)
(heavy vehicles)		vph	2 (2)	0 (0)	2 (2)	2 (2)
Inter-WTG cabling delivery		vpd	1 (1)	0 (0)	2 (2)	2 (2)
(heavy vehicles)		vph	1 (1)	0 (0)	1 (1)	1 (1)
Water deliveries		vpd	18 (18)	0 (0)	36 (36)	36 (36)
(heavy vehicles)		vph	6 (8)	0 (0)	6 (8)	6 (8)
Other miscellaneous construction		vpd	2 (2)	0 (0)	4 (4)	4 (4)
deliveries (HVs)		vph	1 (1)	0 (0)	2 (2)	2 (2)
TOTAL	Light vehicles	vpd	120 (200)	20 (40)	240 (400)	240 (400)
		vph	60 (100)	10 (20)	120 (200)	120 (200)
	Heavy vehicles	vpd	45 (51)	0 (64)	90 (96)	90 (96)
		vph	15 (20)	0 (2)	16 (21)	16 (21)
	OSOM vehicles	vpd	0 (10)	0 (10)	0 (10)	0 (10)
		vph	0 (4)	0 (4)	0 (4)	0 (4)

The primary Project Site entry will only be accessed from a westerly direction (from Goolma road along Twelve Mile Road), except to allow local service and/or resource suppliers located east of the primary Project Site entry along Twelve Mile Road the opportunity to participate in the Project. Therefore, an exception is sought to not prohibit Heavy and Light Vehicles to use Twelve Mile Road east of the primary Project Site entry should service and/or resource suppliers be identified.

A short section of Ilgingery Road will be used during construction and operational activities for OSOM, Heavy and Light Vehicles, which for the absence of doubt, will gain access via the primary Project Site entry and Internal Roads, to access a small number of WTGs at the western edge of the layout.

The sections of Uungula, Wuuluman and Ilgingery Roads linking the Project back to Twelve Mile Road will not be used by the Project during the post-Development Consent, construction or operational periods for any vehicles, except to: -

a) undertake Pre-construction Minor Works;

b) construct intersection upgrades on Uungula Road and Ilgingery Road;

c) undertake dust suppression;

d) utilise the secondary intersections and cross overs identified above to facilitate construction and operational vehicles; and

e) procure resources from licensed operators which are located along these roads.

Staffing arrangements during construction will depend on the staging of the development. Staffing figures are based on a 24 to 30 month construction period, however, depending on staging and resourcing this could extend to 18 months. It is expected that two construction staff would share a single Light Vehicle from surrounding urban centres such as Wellington and Dubbo, however car-pooling and use of buses for staff movements will be utilised where possible. Peak staffing estimates are provided in Figure 8-25.

Table 8-32: Staffing estimates

Stage	Duration	Peak Staff	Hours of operation
Construction	Up to 30 months	250 (peak)	Monday to Friday 7.00am to 6.00pm Saturday 8.00am to 1.00pm No work on Sunday or public holidays.
Operation	30 years	Up to 12 direct and 35 indirect FTE to remotely operate and maintain the plant	Monday to Friday 7.00am to 6.00pm

Material deliveries will depend on day to day construction requirements. Heavy vehicles into the site are estimated to be approximately 45-48 vehicles per day during construction activities and OSOM vehicles are estimated to be approximately five vehicles during WTG component delivery (during a timeframe of between 24 – 30 months). This includes provision of the WTGs, steel and cable deliveries, as well miscellaneous deliveries to the Site. There is potential that peak truck movements could be up to 96 heavy vehicle movements in some situations due to weather delays, logistical delays, where the construction schedule pace is increased, or where particular operations require a higher frequency of truck movements for a shorter duration.

8.5.3.3 Internal Roads

The Internal Road layout has considered topography, drainage and potential erosion impacts and is further detailed in Figure 1-2. Internal access roads will be constructed of compacted gravel and crushed stone, as well as recycled aggregate extracted from construction excavations. The internal access roads are to be located wholly within the Project Site and would not be accessible to the public at any stage. Periodical maintenance of internal access roads between the WTGs would be undertaken when required throughout the operational phase to ensure the WTGs are accessible to full-time staff and contractors.

8.5.3.4 Operation & Maintenance

At the conclusion of the construction phase anticipated traffic numbers will be substantially lower and there is an estimated 12 direct and 35 indirect FTE maintenance staff on-site throughout the year, making routine checks of the WTGs ESF and Ancillary Infrastructure (Ethos Urban, 2020). On-site maintenance staff (FTE) will require permanent access to the WTGs and ESF to address technical and mechanical servicing requirements. Furthermore, one-off replacement of major components (such as blades) may require the use of cranes and ancillary equipment. Also, during the operational phase, routine management of regrowth and obtrusive vegetation will be necessary along access tracks, on hardstand areas and within the overhead transmission line corridors. Routine clearing and slashing will be carried out in these areas prior to construction works commencing and as part of the ongoing management of the Project Site.

8.5.3.5 Decommissioning

At the end of the operational life of the Project, all above ground infrastructure including the WTGs will be dismantled and removed from the Project Site. This may not include the connection infrastructure which may be essential to be retained. WTG bases would be excavated to below tillage level for agricultural activities or topsoil built up over the footing to achieve a similar result. The land will mostly be returned to its prior condition and use (agriculture).

Internal Roads, if not required for ongoing farming purposes or fire access, would be removed and the Project Site reinstated as close as possible to its original condition and use. Access gates, if not required for farming purposes, would also be removed. The proposed haulage route and potential mitigation measures will be determined towards the end of the operational period of the Project as the existing road infrastructure may be changed. As a generalization, the decommissioning haulage route will be the same as the construction haulage route and mitigation measures to address potential adverse impacts are also comparable. Based on the assessment of the road capacity along the preferred transport route during the construction phase, traffic and road network impacts would be minimal with the proposed local road upgrades as described in Appendix L, Appendix M and Appendix N.

Although the road network conditions at the completion of the Project in 30 years are unknown, it is considered that based on current conditions, the road network would have significant spare capacity and be able to accommodate the necessary heavy vehicles to be used during the decommissioning. Appropriate management plans for road upgrades and traffic control would be prepared prior to the decommissioning phase and in conjunction with the relevant road authorities. This would aim to ensure adequate road safety and road network operations are maintained to a high standard.

8.5.3.6 Cumulative Impacts

There are several nearby major projects that may cause cumulative impacts with the Project, including the following:

- Crudine Ridge Wind Farm (construction commenced in August 2018 and is ongoing);
- Liverpool Range Wind Farm (currently in pre-construction phase); and
- Nearby solar farm projects at Wellington, Wellington North, Maryvale and Mumbil.

Once the construction dates/timetables are finalised for the Project, the cumulative impact of the above projects (and potentially other future projects) would need to be considered with respect to transport and traffic operations. Any cumulative impacts arising from the Project would be considered in detail as part of the Traffic Management Plan (TMP) and mitigation measures implement. Typical mitigation measures may include:

- Independent scheduling of construction activities and deliveries for each project so that they do not overlap in order to minimise road transport movements;
- Region-wide traffic management;
- Shared road infrastructure upgrade works;
- Targeted dilapidation and reinstatement programs; and
- Collective community consultation programs (Samsa Consulting; 2020; Appendix L).

Other concurrent major projects would not use the local road network within vicinity of the Proposed Development, hence cumulative traffic impacts would be restricted to State roads, and the Golden Highway which has capacity for additional traffic flows, if required.

Traffic generation during the operational phase would be minimal resulting in between 30 – 40 vehicle movements per day. Consequently, traffic and road network impacts would be negligible during the operational phase and the nominated route for non-OSOM vehicle movements is not restricted.

8.6 Hazards / Risks

An environmental hazard is an item or situation that has the potential to threaten the environment or human health. In order to respond to potential community concerns, the Project responds to recognised technical guidelines identified within the SEARs to identify appropriate design considerations and mitigation strategies. Further information is provided in the sections below.

8.6.1 Introduction

This section provides an assessment of potential hazards and risks associated with the Project and addresses the SEARs under the following sub-sections:

SEARs item	Sub-section/s
Aviation Safety	8.6.2Aviation
Telecommunications	8.6.3 Telecommunications
Health	8.6.4 Health: Electromagnetic Fields 8.6.5 Health: Low Frequency Noise and Infrasound 8.6.6 Health: Shadow flicker & blade glint
Battery Storage	8.6.7 The Energy Storage Facility (ESF)
Bushfire	8.6.8 Bushfire and Electrical Fire
Blade Throw	8.6.9 Blade Throw

This section considers the latest advice from the NHMRC and relevant guidance within NSW, in particular SEPP 33, to determine if the Project is potentially hazardous, then applies a risk screening and PHA in accordance with NSW DPE's SEPP 33 Guidelines. It assesses potential hazards identified regarding aviation, telecommunications, the potential for adverse effects on human health and wellbeing by electromagnetic interference, electrical and bushfires, and blade throw.

Detailed mitigation and management measures are provided in Appendix O, Appendix T and Appendix U, and are summarised in Environmental Management (Section 9) as Statement of Commitments HR001 (Aviation), HR002 (Telecommunications), HR003 (Electromagnetic Fields), HR004 (Low Frequency Noise and Infrasound), HR005 (Shadow flicker and blade glint), HR006, HR007, HR008, HR009, HR010 (Bushfire and Electrical Fire), and HR011 (Blade Throw).

8.6.2 Aviation

This section presents an assessment of existing aviation facilities and activities in the vicinity of the site, potential local and regional impacts the Project may have on these activities, and appropriate mitigation measure where required. This assessment includes the results of an independent Aeronautical Impact Assessment (Landrum and Brown Worldwide (Aust), 2020; Appendix O). The SEARs require the Proponent to:

- *assess the impact of the development under the National Airports Safeguarding Framework Guideline D: Managing Wind Turbine Risk to Aircraft;*
- *provide associated height and co-ordinates for each turbine assessed;*
- *assess potential impacts on aviation safety, including cumulative effects of wind farms in the vicinity, potential wake / turbulence issues, the need for aviation hazard lighting, considering, defined air traffic routes, aircraft operating heights, approach/departure procedures, radar interference, communication systems, navigation aids;*
- *identify aerodromes within 30 NM of the turbines and consider the impact to nearby aerodromes and aircraft landing areas;*
- *address impacts on obstacle limitation surfaces, and*
- *assess the impact of the turbines on the safe and efficient aerial application of agricultural fertilisers and pesticides in the vicinity of the turbines and transmission line;*

The methodology Landrum and Brown used for conducting the assessment was also based on the assessment requirements relevant to large scale wind farm development from several agencies, including the Department of Infrastructure Regional Development and Cities, CASA, AsA, Airport Operators and the DoD. Other relevant standards and guidelines considered for this assessment and additional methodology can be found in Appendix O.

8.6.2.1 Existing Environment

Mudgee Airport and Dubbo Airport, Wellington aerodrome (Bodangora aerodrome), and the Gulgong Aero Park are all located within 30 nautical miles (nm) to the Project Site. There is also high probability for other aviation activities as unlicensed private air strips to exist within proximity to the Project Site. There is one known grass runway within the site boundary and three known grass airstrips upon adjacent land.

Airspace Around Aerodromes

Airspace associated with an aerodrome may comprise of OLS or Procedures for Air Navigation Services (PANS-OPS) surfaces. Areas containing OLS may be suitable for WTG placement though PANS-OPS surfaces (which extend 55 km from an aerodrome) cannot be infringed upon, these limitations are discussed in Appendix O.

The aeronautical requirements for marking and lighting of winds farms is under review by regulatory bodies as listed in Appendix O. Currently, CASA cannot mandate obstacle lighting on non-operationally significant wind farms, including the Project.

Military Low-Level Flying

Pilots undertaking authorised low-level operations undergo specialised training and plan when conducting their low-level operations. Inclusion of WTGs on aeronautical charts will provide information for pilots planning to operate in the vicinity of the Project Site.

The DoD indicates that the Project will be outside any areas affected by the Defence Regulations (Appendix O). CASR Part 139.365 requires a person proposing to construct a building or structure, the top of which will be 110 m or more above ground level, to inform CASA of that intention and the proposed height and location of the proposed building or structure. In April 2005 (revision in March 2018) CASA released advisory circular *AC 139- 08(0) Reporting of tall structures*, providing guidance on how tall structures were to be reported to CASA, defining a tall structure as “Any obstacle, or parts thereof, that are located 100 m or more (above ground level)”.

The RAAF stipulate that a tall structure is one which "the top measurement of which is 30 m or more above ground level — within 30 km of an aerodrome, or 45 metres or more above the ground elsewhere". The Project Site meets the above definition. The DoD requests that the Proponent provide RAAF with "as constructed" details for inclusion on aviation charts. Furthermore, CASA will conduct an aeronautical study to determine if the WTG will be a hazardous object to aviation, in accordance with the regulations (CASR 139.370).

Transitioning Civil Air Routes

Aircraft may operate under either Instrument Flight Rules (IFR) or Visual Flight Rules (VFR). Since IRF Pilots may be relying solely on flight instruments, a lowest safe altitude (LSALT) is published for each air route. For VFR flights, the minimum statutory height is 152 m, (500 ft) above ground level in non-populous areas. VFR traffic in daylight may operate anywhere provided they do so in Visual

Meteorological Conditions (VMC). During these conditions wind farms would be visible and have no impact on flying activity. Night VFR pilots must fly at or above the IFR LSALT for the route.

Designated Airspace

Special use airspace is defined either as Prohibited, Restricted or Danger areas. WTGs are not allowed within Prohibited or Restricted areas. Danger areas are locations where WTGs may not be compatible with the activities undertaken there. CASA may also elect to designate a Danger area around a wind farm. There is no restriction on the entry of Danger areas by aircraft.

Air Traffic Control Surveillance, Communications and Navigation Aids

Primary Surveillance Radar (PSR) and Secondary Surveillance Radar (SSR) are used for air traffic control, and Route Surveillance Radar (RSR) is located along busier air corridors. Tall structures may interfere with electromagnetic transmission as discussed in more detail, under subsection 1.1.3 *Electromagnetic Fields.* Since the PSR does not provide height information, the air traffic controller may divert aircraft which may be in the vicinity of the wind farm within PSR coverage. Radar coverage must be guaranteed within controlled airspace which extends from ground level in airport control zones (CIR) and from 2,591 m (8,500 ft) in *en-route* airspace.

AsA provide air traffic control management with a network of 19 radars. To determine if further assessment of the impact of the Project on radar facilities is required, the Eurocontrol *Guidelines on How to Assess the Potential Impact of Wind Turbines on Surveillance Sensors* must be considered. This is provided in the Aeronautical Impact Assessment (Appendix O)

Radio navigation aids are ground-based systems that rely on the transmission/reception of signals to determine the location of an aircraft. WTGs may interfere with radio signals as discussed further under Section 8.6.4. The closest navigation aid to the Project Site is at the Mudgee airport, located 34 km from the Project.

Large scale power generation, including wind farms, may also cause electromagnetic interference (EMI) with on-board radio communication equipment of aircraft flying in the vicinity. However, according to the available literature this affect is considered negligible due to the standards which apply to WTG construction.

Other Aviation Activities

It is possible that aircraft will intermittently fly over the Project Site to undertake activities including aerial spraying or bushfire control. There is also likely to be other privately-owned, unlicensed airstrips in the area that are not published in the Aeronautical Information Publication. Owners of these private grass airstrips are responsible for ensuring the condition of the airstrip and surrounding terrain is still operationally safe. Ongoing consultation throughout the Project development will create community awareness for any privately-owned airstrips.

VFR flight activities are common from Wellington and Gulgong airstrips. The Project is not anticipated to be an issue for VFR operations in the area due to the requirement to adhere to Visual Meteorological Conditions required for flight and the prominence of the wind farm as a navigation feature. Glider flights are carefully planned and will be at an altitude well above the wind farm.

Turbulence from each WTG can affect flights 2 km downwind of the WTG. Advice contained within the NSAF Guideline D should be followed noting that wind farm operators should be conscious of their duty of care to communicate with aviation operators that may be affected.

High tension transmission lines already exist between Wellington Aerodrome and the Project Site. Pilots who fly this route would have already included these in their flight operations plan and as such these procedures will also ensure a safe margin for transmission lines associated with the Project.

8.6.2.2 Potential Impacts

Airspace Around Aerodromes

Tall Structures have the potential to obstruct or present safety hazards for aircraft, particularly if sited in an OLS, PANS-OPS, or in areas with high levels of air traffic. The Project is further than 4 km from any aerodrome represented on aeronautical charts and does not infringe or impact on the OLS of any known aerodrome. The Project is within 55 km of Mudgee Airport, with the lowest PANS-OPS protection surface at an elevation of 1,067 m (3,800 ft) AHD. As the WTG maximum blade tip elevation is 3,186 ft, the Project will not impact any PANS-OPS surfaces. The Project is not expected to have any impact on civil air traffic operating under either IFR or VFR but will rather act as a prominent feature which may assist in visual navigation. The International Civil Aviation Organization considers WTGs in excess of 150 m an obstacle and as such, lighting is recommended under the Proponents Duty of Care – though not mandated by CASA. In accordance with CASR 139.370, the outcomes of the Aviation Impact Assessment will be submitted to CASA for their comment pending Development Approval for the Project.

Lighting facilities on WTGs or around wind farms have the potential to have two primary impacts. The first is the visual amenity of the Project area at night (refer to Section 8.2), both for local residences and visitors. The second impact relates to local bird and bat populations (refer to Section 8.4). Some bird and bat species are known to be attracted to some types of lights. This attraction may increase the probability of interaction with the WTG blades.

Military Low-Level Flying

The Project is not located within any areas designated for low-level military flying exercises and the DoD will be notified of the Project.

Transitioning Civil Air Route

The Project is within 5 nm of five IFR flight paths and located within one Grid LSALT area. All LSALTs have a positive clearance from the proposed maximum blade tip heights and the wind farm will therefore not impact on any LSALT protections.

Designated Airspace

The Project Site is not located within any designated areas and therefore flying provisions and restrictions in terms of designated airspace do not apply to the Project.

Air Traffic Control (ATC) Surveillance, Communications and Navigation Aids

The Project Site is located outside of 200 km from any ATC surveillance radar or system as well as outside of any clearance zone for these systems and will therefore have no impact. Clearance zones for radio navigation aids for Mudgee are up to 3 km from the navigation aid, at 34 km from the navigation aid, the Project will have no impact on these systems.

Other Aviation Activities

It is unlikely that aircraft operations will be conducted within the Project Site, between WTGs, or whilst WTGs are active. Individual WTGs can be turned off to help facilitate activities, though proper planning and publication of WTG locations in aeronautical charts will allow pilots to manage these risks.

Agricultural and firefighting activities or other scenarios that require low level flight must only be undertaken in good conditions (high visibility) in accordance with aviation regulations – during which WTGs can be considered as highly visible structures.

Some localised turbulence may be present; however, as the closest aerodrome, Wellington Airport, is further than 2 km away in any wind condition and it is unlikely that turbulence caused by the WTGs will have an impact on operations there.

Cumulative Impact

The Project will be located 7 nm from the Wellington aerodrome, outside of its recognised circuit area and beyond the boundary of its OLS. A wind farm has recently been constructed approximately 10.6 km north of the Project Site, within 5nm of the aerodrome. As such, it is not anticipated that the Project will create additional risk to flight operations beyond what is currently present.

Radar coverage and performance is subject to potential cumulative effect. Preliminary assessment shows that the Project Site and Bodangora Wind Farm are in excess of 200 km from the nearest SSR and would have no impact upon these systems.

8.6.2.3 Summary

The Aeronautical Impact Assessment must be referred to AsA, CASA and the DoD for their assessment of any likely impact upon their systems as well as published air routes. Furthermore, final built details of the wind farm will also be required to be provided to these bodies for publication in aeronautical databases and charts.

8.6.3 Telecommunications

This section summarises the findings made in the Telecommunications and EMI Study conducted by Middleton Group (Appendix T). The report identifies the existing radio, telecommunications and communications systems already operating within the region. It also provides an assessment of the potential impacts and interference effects that may be caused by the Project and suggests mitigation measures. The SEARs require the Proponent to:

- *identify possible effects on telecommunications systems, assess impacts and mitigation measures including undertaking a detailed assessment to examine the potential impacts as well as analysis and agreement on the implementation of suitable options to avoid potential disruptions to radio communication services, which may include the installation and maintenance of alternative sites.*

Electromagnetic signals (radio waves) are transmitted throughout the country as part of telecommunications systems used and maintained by a large range of operators (as opposed to Electromagnetic fields which are different and assessed separately in this section under Sub-section 8.6.4). These systems are used for radio, radar, broadcast, television, mobile networks, as well as mobile and fixed radio transmission sites. Electromagnetic signals usually work best when there is a clear line of unobstructed sight (LOS) that exists along a path from the transmitter to the receiver.

There is the potential for large structures, including WTGs, to introduce interference when they occur close to or within the signal path. Signals can be interfered with or be reflected buy the rotating blades of WTGs, which could degrade the performance of the signals (Bacon, 2002). Electromagnetic emissions can also be produced from mechanical generators and machinery and have the potential to affect signals; however, modern WTG technology and manufacturer regulations from the International Electrotechnical Commission (IEC) have resulted in negligible emissions from WTGs (Auswind, 2006).

8.6.3.1 Existing Environment

Radio Communications

Four point-to-point (PtP) links exist within 1 km of the WTGs and these were considered in the assessment. These links are operated by the Dubbo Regional Council, NSW RFS, NSW Police Force (NSWPF), Country Energy and TransGrid (often with receivers and transmitters owned by different entities). No WTGs are in the near-field zones of any receivers or transmitters, nor are they within reflection or scattering zones. One WTG is located near the signal paths of a PtP link – WTG 105. This link is a 54 km Ultra High Frequency (UHF) link between Dubbo Regional Council's Mt Bodangora Site and the NSW RFS site at Store Creek. In reviewing the site information, it was noted that satellite imagery (most recent imagery from September 2018 from Google Earth) of the RFS Site at Store Creek did not show any obvious transmitter/receiver at this location. Should the mapped location be incorrect, and the observed communication tower is the actual site location, this will shift the link to the west, further reducing any impact of WTG 105 on this link. No low power Frequency Modulated (FM) or digital radio transmitters exist within a 10 km radius of the Project.

Television

Residents within the Project area receive television reception primarily from transmitters within the Mid-western Regional Council LGA and, as well as Canberra and the Central Tablelands. Digital television (DTV) signals generally require 2 km of interference clearance around transmitters as WTG rotor pass can cause signal frequency variation. The Project is located outside of 10 km from any DTV transmission sites and will not impact on any known DTV signals.

Air Services Radar

The closest AsA radar facility is located approximately 225 km south of the Project at Bobbara Mountain, as well as an ATC communications system approximately 80 km south of the Project (Mount Canobolas) and the closest Non-Directional Beacon at Mudgee Airport 34 km away from the Project.

The potential impacts WTGs will have on these services and mitigations to these are provided in Section 8.6.2. AsA have been notified about the Project and it is considered that there will be no impact on very high frequency (VHF) services or radar due to the separation and distance of the Project from these services.

Mobile Phones

Mobile phone reception within the study area is relatively weak. The nearest mobile phone point base station is approximately 13 km from the Project. Generally, no interference will be detectable from a WTG unless within 1 km of the mobile phone point site, so it is considered that the Project will have negligible impact on these services.

8.6.3.2 Potential Impacts

Radiocommunications

PtP and point to multipoint (PMP) services generally require a clear LOS and can therefore be easily affected by objects within the LOS pathway. If objects are placed outside of the 1st Fresnel Zone (otherwise called the zone of electromagnetic interference), impact to the signal pathway can be avoided. The 1st Fresnel Clearance Zones of the PtPs which cross the project area will not be intersected by the WTGs as seen in Figures 9 and 10 of Appendix T. No WTGs are located within interfering distance of any transmitting of communication point or tower, and as such that Project can be considered to have no impact on exiting PtP links using this infrastructure.

Usually PMP services operate using only a base station that is registered, with the remote end unknown which can make the impact of wind farms difficult to assess. Given that all base stations in the area are remote from the Project Site there is a low probability that any paths would cross the Project.

Radio Frequency broadband noise generated by transmission lines could be received by radio receivers or terminal sites if they are co-located close by, causing interference. This is generally not an issue as transmission lines today are built to standard specifications that reduce potential impact. Poles, towers and wires that are a part of the transmission infrastructure may also physically obstruct radio signals; however, given the low height and limited dimensions of these features, the likely impact is low.

Amplitude Modulation (AM) and FM radio transmission systems are subject to negligible impacts from wind farm projects and effects only occur at very small distances from WTGs (within tens of metres) (National Research Council, 2007). This will be no different at the Project Site.

Mobile radio services do not require a totally clear LOS and so are less suspectable to interference by other structures.

Television

WTGs may interfere with analogue television signals by causing the picture to flicker or 'ghost' in time with the rotation of the blades, also known as scattering or reflection. Analogue transmission is now largely, if not completely phased out across most of Australia in favour of DTV, on which wind farm interference has much less of an effect. The Project Site is located outside 10 km from the nearest DTV transmission point and will therefore have no effect on DTV signals in the area.

Mobile Phones

Mobile phone reception is largely based on the position of the receiver, which can move around natural and man-made objects and structures in the landscape. WTGs will have minimal effects on signal quality in this case. Further, there are no mobile transmission towers within 10 km of the Project Site, and so mobile signals at these sites will not be impacted.

Telstra is the predominant mobile service provider for rural areas of NSW. Their response to consultation indicated that the locations of the WTGs were unlikely to affect any of their systems, however requested the frequencies to be used for wireless communications systems required for the Project. Given that these will be in line with the ACMAs regulations on these frequencies, it is unlikely that there will be an impact on existing systems.

Cumulative Impacts

As each wind farm project must assess its potential impact on communications links in the area and provide mitigation measures if any impact is to occur, it is anticipated that any potential cumulative effect on communications links from proposed or existing wind farms will be covered by appropriate mitigation measures highlighted in the respective project's EIS.

8.6.4 Health: Electromagnetic Fields

This section considers the potential adverse impacts from Electromagnetic Fields (EMFs) associated with the Project on people within close vicinity of the Site and the wider community. In accordance with relevant guidelines, consideration is given to human health and safety as well as potential interruption of existing services during the construction, operational and decommissioning phases of the Project. The SEARs require the Proponent to: -

- *consider and document any health issues having regard to the latest advice of the National Health and Medical Research Council, and identify potential hazards and risks associated with electric and magnetic fields (EMF) and demonstrate the application of the principles of prudent avoidance;*

EMFs are electric and magnetic fields that are produced wherever electricity is expended. EMFs are produced by electrical equipment of all size and voltage. They also occur naturally, such as the build-up of electric charge in thunderstorms or within the Earth's magnetic field. Electric and magnetic fields occur simultaneously but are independent of one another. Electric fields are produced by voltage and measured in volts/metre, while magnetic fields are produced by current and measured in gauss (g) or tesla (T). The strength of both electric and magnetic fields reduce quickly with distance, and while electric fields are insulated to an extent by their surroundings (buildings or the earth in which cables may be buried), magnetic fields are not.

Radiation levels exists across a spectrum from very high-energy radiation to very low-energy radiation. This is sometimes referred to as the electromagnetic spectrum. The electromagnetic spectrum represents all the possible frequencies of electromagnetic energy. It ranges from extremely long wavelengths (extremely low frequency exposures such as those from power lines) to extremely short wavelengths (x-rays and gamma rays).

8.6.4.1 Existing Environment

Human-made EMFs fall into both the Extremely Low Frequency (ELF) and radiofrequency categories of non-ionizing part of the electromagnetic spectrum. These EMFs can come from several sources and existing potential sources at the Site include low voltage distribution lines, electrical wiring in homes and electrical appliances such as hair dryers and electric blankets. In Australia, transmission lines and other electrical devices operate within the range 49.85 Hz to 50.15 Hz and fall within the ELF range of 0 – 300 Hz. ELF EMFs exist close to cable wires and powerlines that carry electricity and any operating electrical devices or appliances. Australians are routinely exposed to these fields to varying degrees in everyday lives and environmental exposure to man-made electromagnetic fields has been steadily increasing as growing electricity demand, ever-advancing technologies and changes in social behaviour have created cumulative artificial sources.

Exposure refers to the circumstance of being in the immediate presence of electric or magnetic field, or having such fields cause electric currents to flow through the body or within the body. Short-term exposure to very high levels of EMFs can be detrimental to human health; however, exposure to EMFs generated within the ELF range and at the low levels experienced in day-to-day activities, do not have substantive impacts to health (ARPANSA, 2015). This is the case for the EMFs that would be produced by components of the Project.

The WHO concluded that an in-depth review of current evidence does not confirm the existence of any health consequences from day-to-day exposure to low frequency EMFs (WHO, 2020). Furthermore, advice from the Australian Radiation Protection and Nuclear Safety Agency (ARPANSA, 2015) indicates that scientific evidence provides that exposure to 50 Hz electromagnetic fields near transmission lines has not been established a human health hazard, and concludes that where any risk does exist, it would be comparatively small and not warrant any concern (ARPANSA, 2015).

Without Australian Standards for regulating exposure to extremely low frequency EMFs, the NHMRC *Interim guidelines on limits of exposure to 50/60 Hertz electric and magnetic fields* has been used to assess the impact of the existing infrastructure (transmission lines) and Project infrastructure (WTGs and battery storage) to the health of contractors and the general public or receptors (Table 8-33). The NHMRC is Australia's peak body for supporting health and medical research; for developing health advice for the Australian community, health professionals and governments; and for providing advice on ethical behaviour in health care and medical research.

Table 8-33: Summary of NHMRC's Interim Guidelines on limits of exposure to 50/60 Hz electric and magnetic fields

Exposure characteristics	Electric field strength (volts per metre – kV/m)	Magnetic flux density (Microtesla - µT)
Occupational		
Whole working day	10	500
Short term (maximum exposure is 2 hours/workday)	30	5,000
General public		
Up to 24 hours/day	5	100
Few hours/day	10	1,000

8.6.4.2 Potential Impacts

Generating, transmitting, distributing, and using electricity all expose people to ELF radiation. Power lines, household wiring, and any device that uses electricity can generate ELF radiation. Therefore, any electric device, including refrigerators, personal computer monitors (when they are on) and underground electric cables are sources of ELF EMFs.

The amount of electromagnetic radiation you are exposed to depends on the strength of the electromagnetic field, your distance from the source of the field, and the length of time you are exposed. The highest exposure occurs when the person is very close to a source putting out a strong field and stays there for a long period and the intensity of radiation decreases with distance from the infrastructure. EMF levels for underground infrastructure, including electrical cables is further diminished with the provision of fill (to a depth of approximately 900 mm).

When people are exposed to EMFs, electric fields and currents are generated inside the body and they can interfere with the body's own electric fields and current flows that are related to normal biological functioning. The low frequency or static electric field interacts as a surface charge on the body. At low levels these interactions go mostly unnoticed by the body and do not compromise health. If a charged object and an object connected to ground (where either of the two might be a person) come into contact, a discharge sometimes through a spark occurs. The effect is like that of a field generated by electric fields and currents.

Above a certain level of exposure, referred to by the International Commission on non-ionizing radiation protection (ICNIRP) as threshold, the induced internal fields provoke reversible effects on excitable cells in the body such as a faint light flickering in the periphery of the visual field (phosphenes), electric charge effects at the skin level (similar to that experienced when you comb your hair, causing your hair to rise) or a stimulation of nerves and muscles experienced as a tingling sensation. At higher levels LF fields cause irreversible cardio-vascular effects or tissue burns.

The proposed wind farm infrastructure contains several potential sources of ELF EMFs, including the following:

- The ESF;
- Substations;
- Power Conversion Units (PCUs) including transformers;
- The WTGs and associated wiring system; and
- The underground and/or overhead cables connecting the WTGs and ESF with the Substations.

Construction and Decommissioning

The potential for exposure to ELF EMFs during the construction and decommissioning phases is negligible as operational electricity generating infrastructure is required for radiation to occur.

Furthermore, construction of the WTGs would not occur within transmission line easements, limiting exposure of staff and contractors to EMFs.

Operation

Exposure to EMFs would only occur during the operational phase, when the wind farm is in use and capable of generating electricity. The amount of radiation generated would vary due to the type and size of electrical infrastructure on site, and the nature of the equipment. Internal site design and use of perimeter fencing or protective safeguards would ensure the level of radiation is below the NHMRC threshold and complies with international best practice and regulatory requirements under the ARPANSA Legislative framework.

The EMFs produced by generating and exporting electricity from a wind farm and associated storage facilities are very low frequency and do not pose a threat to public health. Furthermore, the proximity of the proposed WTGs to each other and shielding with metal armour effectively eliminates any adverse effects of EMFs from the WTG structures and security fencing would be erected around the Substations and ESF to restrict all access to potential sources of radiation. Exposure by contractors and staff would be limited to intermittent periods, during works at and around the proposed new high voltage transmission lines and substation on site once they are activated. There would be no risk of exposure to the general public or surrounding residents due to the minimum setbacks between the WTGs and associated infrastructure to the public domain. The WTGs and battery storage facilities are sited to ensure radiation levels are below the exposure thresholds under the interim guidelines by the NHMRC and other legislative requirements set by the ARPANSA. Varying levels of ELF EMFs would be present in the following sources:

WTGs

Magnetic fields produced by the WTGs would be significantly less than those produced for household applications and are indistinguishable from background levels within 2 m of the WTG base (McCallum, Whitfield Aslund, Knopper, *et al.* 2014). Therefore, the health risk of EMFs from WTGs would be insignificant and pose no risk to human health.

Battery Storage

The ESF will potentially comprise of enclosed lithium-ion cells (although the type of energy storage is not yet decided and a range of technologies have been considered, including lithium-ion, lead acid, sodium sulphur, sodium or nickel hydride, electrochemical technology (i.e. flow batteries), cryogenic storage and compressed air). High levels of EMFs are not associated with lithium-ion batteries, therefore the EMFs produced by the ESF would also be below NHMRC recommended levels (Appendix T).

Substation

Due to the function of the Substation and the required components, Substations have the highest variation in magnetic fields, ranging from 0.1 μT to 6 μT at the security fence (EMFs Info, 2020). However, due to the locations of the Substations and the security fencing at each substation, EMF exposure to the general public will be below the guideline limits in Table 8-33. Substation infrastructure will be required to collect the internal electrical reticulation to increase the voltage for transmission to connect to the grid. Any electromagnetic fields around the substation infrastructure would be from the existing transmission lines and the proposed overhead lines and underground cables entering the Substation. Three potential locations have been identified for the Substations which are at a minimum distance of 2 km from any nearby residences. Furthermore, the existing overhead 330 kV transmission lines which would be producing a greater electromagnetic field than any additional Project infrastructure.

Transmission Lines

A series of underground and overground transmission lines are proposed to transmit electricity generated by the WTGs with the 330 kV transmission line running in approximately east-west located within the northern part of the Project Site as shown in Figure 1-2. The preliminary electrical layout includes both underground and overhead reticulation connecting the WTGs, the ESF and Substation infrastructure to the existing transmission network (Figure 1-2). The electricity produced by each WTG would be transformed from low voltage to medium voltage (33 kV or greater) by a transformer generally located within or adjacent to each WTG. The internal electrical network will likely comprise 33 kV circuits between the WTGs, the ESF and Substations, and a 132 kV or 330 kV transmission line between the other Substations. Underground transmission lines and control cables will be installed below the ground surface to conduct electricity between the WTGs, the ESF and the Substations. Voltages ranging from 33 kV to 330 kV may be constructed in single or double-circuit configurations depending on the WTG selected for the Project and any staging considerations.

Sections of the proposed overhead transmission lines may need to be placed underground subject to local conditions and conversely sections of the proposed underground transmission lines may need to be placed overhead subject to local conditions. The typical easements for the various overhead and underground lines vary depending on voltage as discussed in Section 4.4.3.1. Typical electric and magnetic field strengths for overhead transmission lines, including the connector are shown in Figure 8-20 and Figure 8-21.

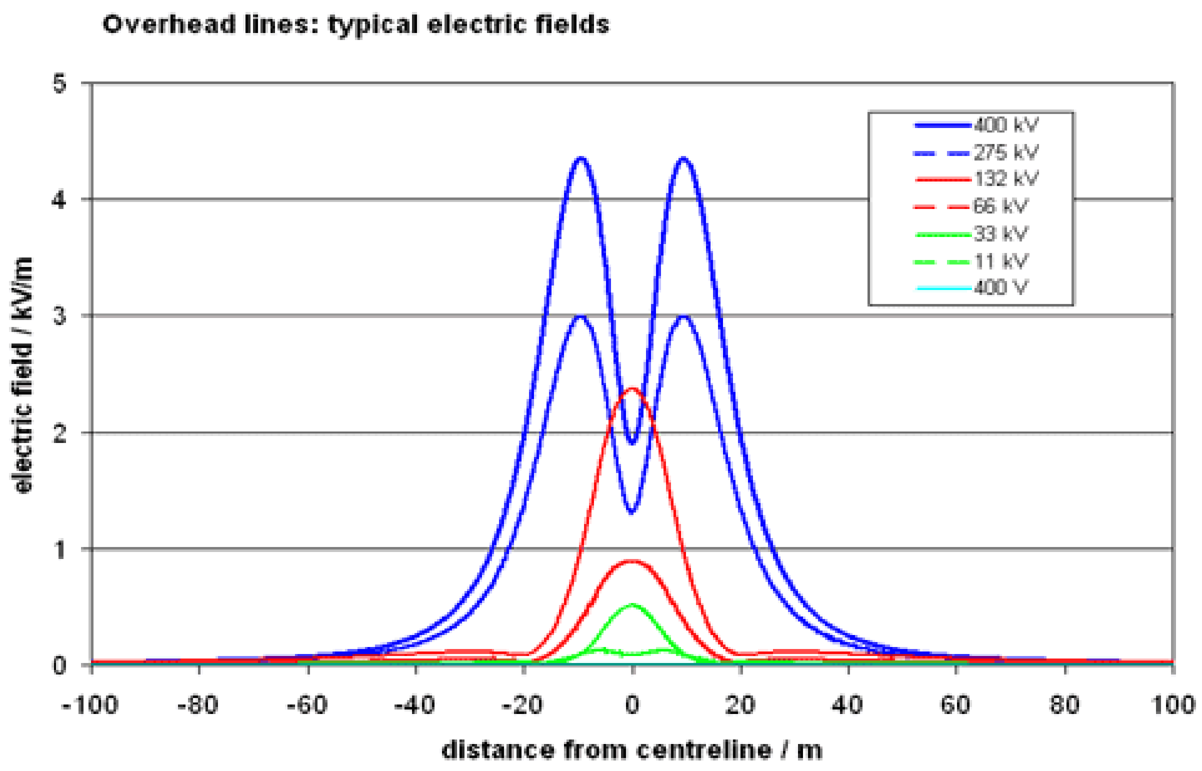


Figure 8-20: Typical electric fields for overhead transmission line (EMFs Info, 2020)

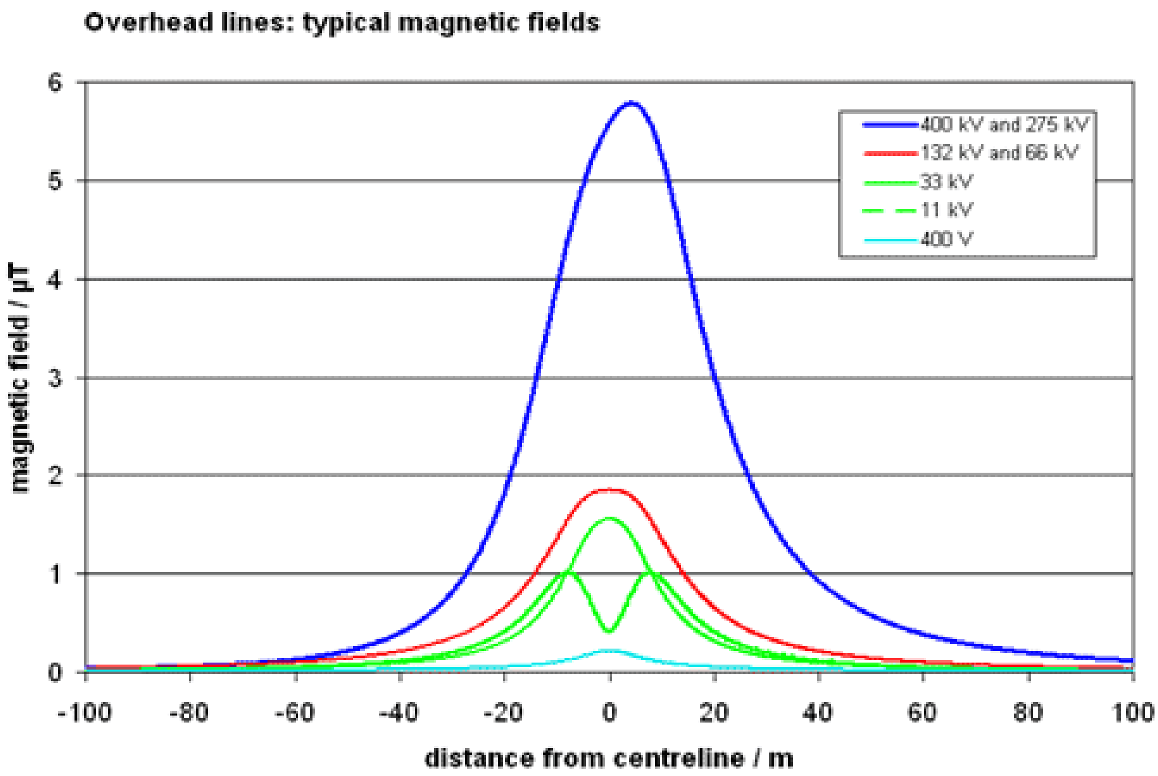


Figure 8-21: Typical magnetic fields for overhead transmission line (EMFs Info, 2020)

The cabling may either be overhead or underground, producing both electric and magnetic fields. The magnetic field associated with the lines would be greatest if installed overhead, with approximately 1.7 µT directly below the line diminishing to 0.4 µT at a distance of 10 m. Under the same scenario, the electrical field would be approximately 2.6 kV/m (2600 V/m) directly below the line, diminishing to 0.7 kV/m (700 V/m) within 10 m (EMFs Info, 2020).

The maximum electric and typical magnetic fields for a 33 kV overhead powerline is shown in Figure 8-22. The maximum electric field produced by a 33 kV overhead powerline is less than 0.85 kV/m (850 V/m) at the source, while the maximum magnetic field produced is approximately 26 µT at the source. The maximum electric and typical magnetic fields for a 132 kV overhead powerline is shown respectively in Figure 8-23.

The maximum electric field produced by a 132 kV overhead powerline is less than 0.85 kV/m (850 V/m) at the source, while the maximum magnetic field produced is approximately 26 µT at the source. These are also below the exposure limits for contractors and the general public as per the NHMRC's Interim Guidelines (Table 8-33) and do not pose a risk to human health to nearby receptors or the wider community.

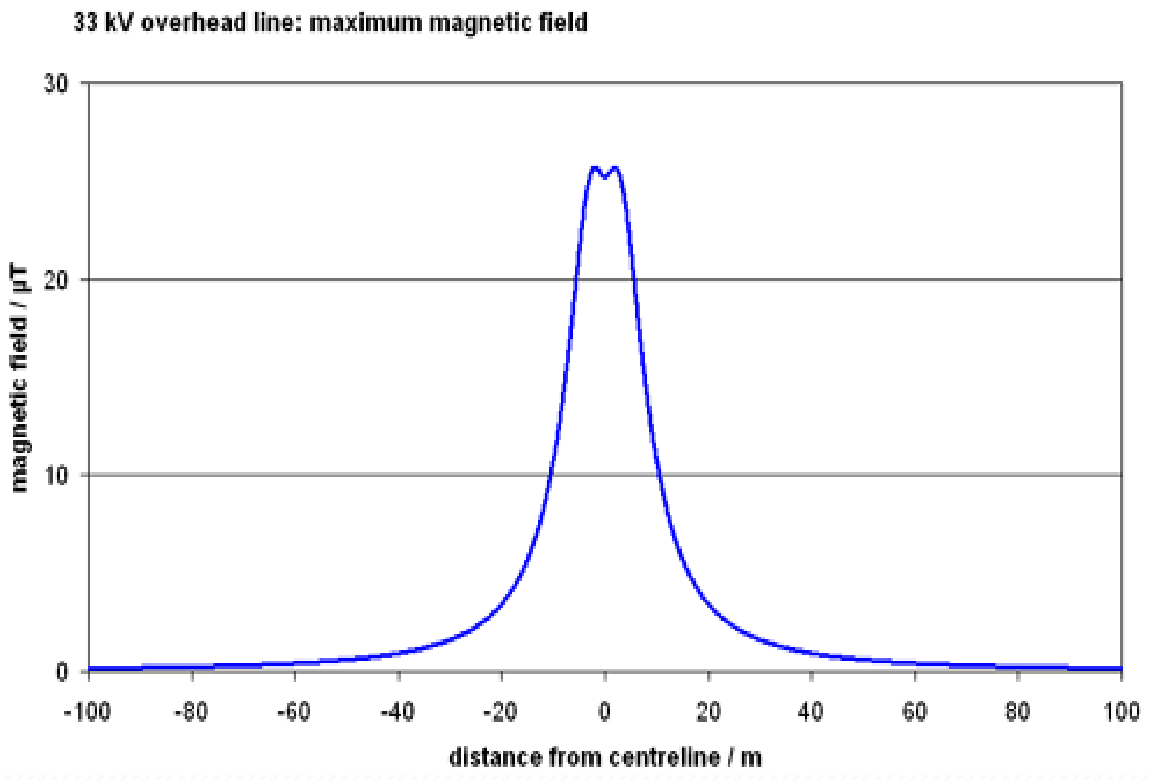


Figure 8-22: Maximum magnetic field from a 33 kV overhead powerline (EMFs Info, 2020)

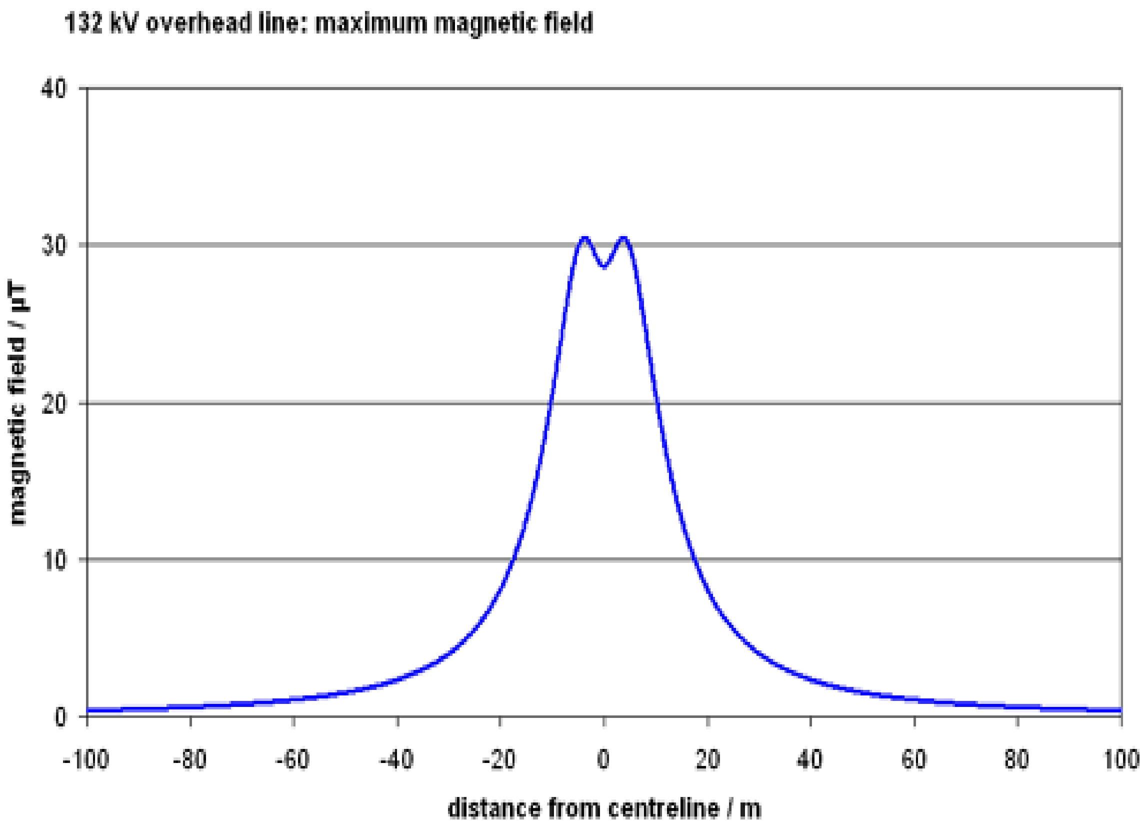


Figure 8-23: Maximum magnetic field from a 132 kV overhead powerline (EMFs Info, 2020)

Underground cables do not produce any external electric fields. The typical magnetic field from the underground cables is 1 µT immediately above a 33 kV cable buried at 0.5 m (Figure 8-24). The typical magnetic field from the underground cables is 9.62 µT immediately above a “three separate cores” 132 kV cable buried at 1 m (or 5.01 µT above a “single cable” line; Figure 8-25). These levels are below the requirements for contractors and public exposure levels as per NHMRC’s Interim guidelines in Table 8-33.

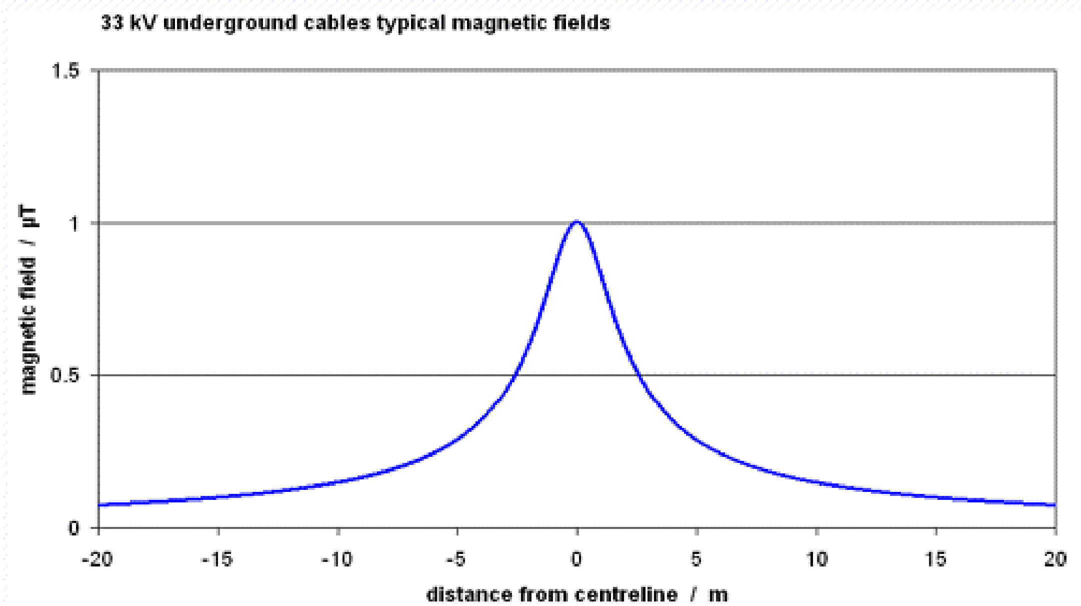


Figure 8-24: Typical magnetic field from a 33 kV underground cables (EMFs Info, 2018)

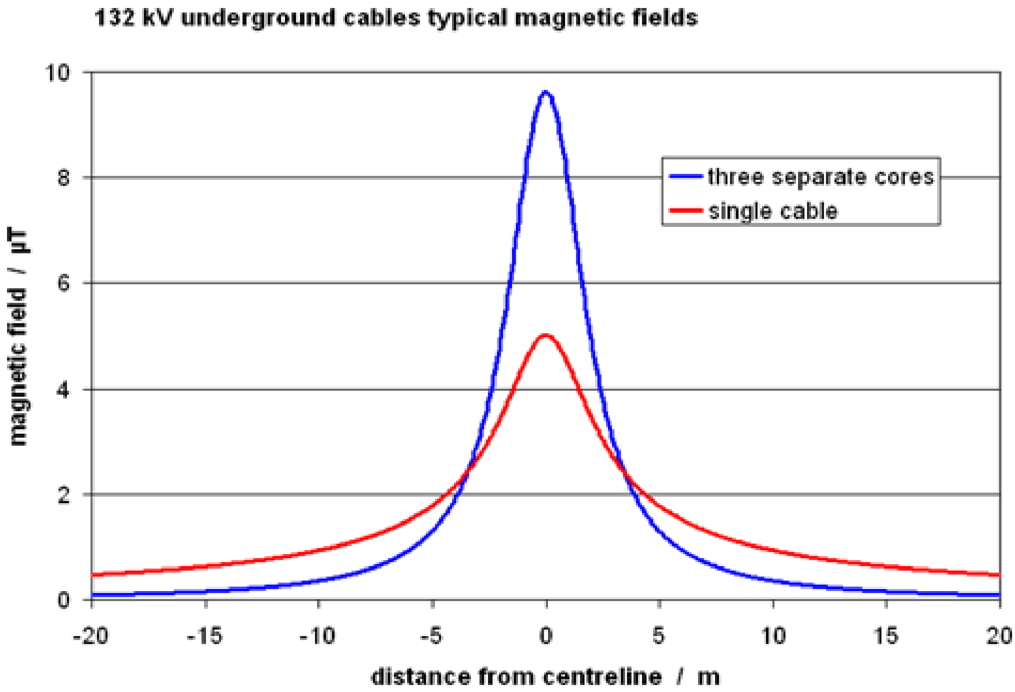


Figure 8-25: Typical magnetic fields for the two main types of 132 kV underground cable (separate cores produce higher fields close to the cable but lower fields away from it)

Receptors – Public Safety

EMFs from the Project are generally well below the requirements for contractors and public exposure levels as per NHMRC's Interim guidelines in Table 8-33. Additionally, given the >2 km distance from the highest EMF emitter (the Substation), and the existing 22 kV local distribution lines located near these residences, EMFs from the Project are likely to be indistinguishable from background levels at all non-involved residences.

Electrical Equipment

All AC electrical equipment that would be used as part of the Project will operate at 50 Hz as per the Australian Standards. In comparison household appliances and devices, as well as telecommunication signals operate at much higher frequencies. For example, microwave ovens and Wi-Fi routers operate at 2.4 GHz, while mobile phones currently operate at 1.8 GHz. As these devices operate at higher frequencies which do not overlap with 50 Hz, and due to the rapid dissipation with distance from the source of EMFs, it is considered that electrical appliances such as these would not be impacted in any capacity by EMFs from the Project.

8.6.4.3 Mitigation Measures

To prevent health-related effects from EMFs, ICNIRP recommends limiting exposure to such fields so that the threshold at which the interactions between the body and the external electric and magnetic field shows adverse effects is never reached inside the body. Academic research and Department of Planning guidelines (SA) for large scale wind farm developments recommended a **policy of prudent avoidance**, whereby electric and magnetic field exposure is reduced wherever practicable and can be achieved at no cost or very low cost. This principal is commonly adopted for development of new sources of electric magnetic fields such as power lines and electricity generating works. The principal seeks to determine "… whatever can be done without undue inconvenience and at modest expense to avert the possible risk…" (Energy Networks Association, 2008). Prudent avoidance does not denote there is an established risk that needs to be avoided. Rather it means if there is uncertainty, then there are certain types of avoidance (no cost/very low-cost measures) that could be practicable to the proposed works. Other mitigation or management actions include providing balanced and accurate information to the community via the website and operate electrical power systems within the relevant health guidelines. Mitigation actions by the proponent include providing adequate training to staff and contractors, informing the community and ensuring sources of EMFs comply with NHMRC guidelines.

Design principles and staff safety

Mitigation measures for the protection of workers include engineering and administrative controls, and personal protection programs. Appropriate protective measures must be implemented when exposure in the workplace results in the basic restrictions being exceeded. Initially, engineering controls should be undertaken wherever possible to reduce device emissions of EMFs to acceptable levels. Such controls include good safety design and, where necessary, the use of interlocks or similar health protection mechanisms. Limitations on personnel access and the use of audible and visible warnings will also help to limit exposure to EMFs, as per the guidelines from the International Commission on Non-Ionizing Radiation Protection (ICNIRP, 2010). This means that: The final design of the Project would meet relevant Australian standards, ensuring EMFs would be minimised as far as possible; and

Access to electrical equipment would be limited to qualified personnel only.

Other possible ways to reduce exposure by EMFs includes effective site design and layout, which may result in increased separation from sources and/or field reduction measures. Methods for mitigating magnetic fields in site design includes:

- Increasing the distance from the source;
- Modifying the physical arrangement of the source;
- Reducing the conductor spacing; and
- Rearranging equipment layout and equipment orientation.

Magnetic field reduction from Substations may be accomplished in a variety of ways, including substation siting, location and orientation or equipment, busbars and cabling and location of accessways/buildings. Locate major magnetic field sources within the substation to increase separation distances. Key magnetic field sources include the transformer secondary terminations, cable runs to the switch room, capacitors, reactors, busbars and incoming and outgoing feeders. Minimising fields from incoming and outgoing powerlines as discussed. Also, orienting equipment so that magnetic fields are minimized.

Receptors – public safety

Potential EMF exposure levels from the Project infrastructure are predicted to be below the exposure limits under the NHMRC's Interim Guidelines (Table 8-33), therefore further mitigation measures from the public domain and associated/non-associated properties are not proposed. No unsupervised public access to the Project Site would be permitted. The landholder or its employees may have access to the Site for grazing activities, however there will be no need to spend extended periods near electrical infrastructure. As such, the potential for impacts from EMFs is low. The landholder or its employees would not have access to the substation or inverters.

Receptors - electrical devices

As noted, electrical equipment commissioned as part of the Project would be designed to reduce possible interference in line with Australian Standards. It would also operate at different frequencies to household electrical devices and telecommunication signals. In addition, due to potential receptors' location outside of the Site, there would be no impact on any electrical devices. Impact to household devices created by EMFs requires no mitigation measures.

8.6.5 Health: Low Frequency Noise and Infrasound

This section considers the potential adverse health effects from low frequency noise and infrasound associated with the Project, to people within close vicinity of the Site and the wider community. In accordance with relevant guidelines, consideration is given to human health and safety as well as potential interruption of existing services during the construction, operational and decommissioning phases of the Project. The SEARs require the Proponent to: -*consider and document any health issues* *having regard to the latest advice of the National Health and Medical Research Council, and identify potential hazards and risks associated with electric and magnetic fields (EMF) and demonstrate the application of the principles of prudent avoidance;*

8.6.5.1 Existing Environment

Sound generated by WTGs is either mechanical sound coming from the machinery in the hub or aerodynamic sounds generated by the blades interacting with the air and causing a distinct 'whooshing' sound. Aerodynamic sounds from WTGs include low frequency noise or infrasound that is caused when the WTG blades encounter localized air stream disturbance from the tower. Low frequency sound contains frequencies within the range of 20 Hz to 100 Hz and infrasound is sound with frequencies below 20 Hz. Within the existing environment, low frequency noise is common as background noise in urban environments, and as an emission from many artificial sources that occur in rural settings, including road vehicles, aircraft, industrial machinery, artillery and mining explosions and air movement machinery including WTGs, compressors, and ventilation or air conditioning units. Historically, concerns have been raised about low-frequency sound and infrasound and their potential adverse health effects to surrounding residents. Health effects from low frequency sound and infrasound draws upon the most recent studies by the NHMRC, *Wind turbines and health* (2010), as well as a current examination of the evidence from literature on WTGs and potential impacts to human health and wellbeing.

8.6.5.2 Potential Impacts

Low frequency noise and infrasound has been claimed to be a source of annoyance, nausea, sleep loss and anxiety, among other symptoms. Historically, ill health effects have been attributed to wind farms including reports of headaches, fatigue, stress and sleep disturbance. Despite this, extensive research on a global scale has shown nil health effects from exposure to low levels of low frequency sound or infrasound as would be experienced by residents next to a large-scale modern wind farm. In the most recent Statement *Evidence on Wind Farms and Human Health* Feb 2015, the NHMRC concludes there is currently no consistent evidence supporting a link between wind energy projects and adverse health outcomes in humans relating to infrasound and that the parallel evidence assessed suggests that there are unlikely to be any significant effects on physical or mental health at distances greater than 1.5 km from wind farms (NHMRC, 2015). Wind farm noise, specifically aerodynamic noise, does produce some level of low frequency noise and infrasound; however, the actual sound levels at receivers greater than 200 m from the WTGs would not be perceptible to the human ear and consequently there is no evidence that infrasound below the hearing threshold causes physiological or psychological effects.

The scientific findings from measured levels of low frequency sound and infrasound and its effects in terms of human health has found a buffer of 1.5 km between sensitive receptors and the WTG structure is considered an adequate setback for non-associated dwellings within proximity to WTGs. To guide large scale wind farm developments in NSW, the State Government has adopted the 2009 South Australian guidelines (*Wind farms – environmental noise guidelines SA 2009*). The guidelines set out the methodology for assessing the noise impacts associated with major projects. Under the guidelines, noise limits that apply outside all non-associated dwellings will be 35 decibels (dB) or background noise plus 5dB – whichever is greater, averaged over a 24-hour period. These noise limits are not dissimilar to existing noise limits that apply to other major developments in rural areas, such as mines. Most environmental sounds with a level of 40 dBA will have approximately the same loudness for human hearing because the A-weighting (that is implied by the A in dBA) is based on the loudness curve of 40 dB (at 1,000 Hz). Such a low to moderate loudness is comparable with actual WTG sound levels at many residences near wind farms (Acoustics Australia, 2018).

See Appendix S for an assessment of audible noise.

8.6.5.3 Mitigation Measures

The NHMRC found that there is currently no published scientific evidence to positively link WTGs with adverse health effects and that based on current evidence, modern wind farms do not pose a threat to human health and safety so long as current planning guidelines and international standards are followed and adhered to (NHMRC, 2015). Ensuing these findings by the NHMRC, wind farm projects are not considered to have any direct health impacts on the local community and/or nearby receptors, rather a perceived disposition based on the views and opinions of the receptor to the project. This can be influenced by whether the receptor is benefiting from the project in the form of compensation or other recompense and evidence on the matter suggests that ill effects in terms of low frequency noise emissions and infrasound are strongly meditated by subjective factors, especially attitudes towards the visual impacts of WTGs. As an early and effective consultation strategy is paramount to mitigating perceived health impacts, the proponent has committed to undertaking effective and meaningful community consultation at all stages of the project. Research by the NHMRC has been undertaken to measure infrasound levels in the vicinity of wind farms and compared to other rural and urban environments. The results of these finding have shown that in rural residences between 1.5 km to 2 km of a WTG, both indoor and outdoor infrasound levels are well below the perception threshold (200 Hz) and no greater than that experienced in other existing environments, both urban and rural. Advances in WTG technology has effectively reduced levels of infrasound from aerodynamic noise caused by the rotation of the blades. All modern WTGs in Australia are designed to be upwind, with the blade in front of the tower. This design generated significantly less infrasound and low frequency sound than previous models. Historically, infrasound was a characteristic of some WTG models that has been attributed to early designs in which WTG blades were downwind of the main tower. The effect was generated as the blades cut through the turbulence generated around the downwind side of the tower. Modern designs have the blades upwind of the tower therefore significantly reducing the level of infrasound. Wind conditions around the blades and improved blade design minimise the generation of the effect (SA EPA, 2003). The following measures are recommended to mitigate and negate any perceived health-related impacts from low-frequency noise and infrasound from the Project:

- Noise levels to comply with the applicable noise guidelines, unless an agreement is in place with the affected landowners; and
- The proposed WTGs are to be constructed with blades upwind of the tower resulting in significantly decreased infrasound noise levels that are well below the level of perception and acceptable noise levels for wind farm developments in rural areas in Australia.

The *NSW Wind Energy Guidelines* (DPE, 2016a) recommends identifying potential receptors of WTG noise, establishing adequate setbacks and dispelling perceptions regarding health concerns that are not supported by medical research in order to mitigate any potential health and safety related issues associated with WTGs. In accordance with the NSW Wind Energy Framework and relevant guidelines, the Project has employed a range of measures to mitigate perceived health and safety impacts including, but not limited to, risk assessment, data collection, impact assessment, detailed technical studies and meaningful public consultation.

8.6.6 Health: Shadow flicker & blade glint

Shadow flicker is the fluctuating light levels caused by intermittent (moving or changing) shadows. If a location is in the shadow of a moving object, then there will be a momentary diminution in light intensity as the shadow passes by. For this assessment, shadow flicker is a visual effect that occurs when rotating WTG blades cause intermittent shadowing as the WTG blades momentarily pass between the sun and the observer. Blade glint is the ability for natural light to be reflected from the surface of WTG blades, potentially causing disruption or nuisance to observers. Its occurrence depends on a combination of circumstances arising from the orientation of the nacelle, angle of the blade, and the angle of the sun.

The SEARs require the Proponent to: consider and document any health issues having regard to the latest advice of the National Health and Medical Research Council, and identify potential hazards and risks associated with electric and magnetic fields (EMF) and demonstrate the application of the principles of prudent avoidance;

8.6.6.1 Existing Environment

Existing sources of glint and glare in a rural landscape are Zincalume sheds and buildings with high levels of reflectivity from the light rays. Some Councils in rural NSW have adopted policies and development standards prohibiting the use of Zincalume clad buildings (roof and wall cladding) to lessen the adverse impacts from glint and glare. The Proponent has undertaken extensive consultation and detailed design in order to minimise the effects of shadow flicker and blade glint on nearby receptors and avoid any adverse impacts wherever they are conceivable. However, blade glint is not generally a problem for modern WTGs, as the blades are coated with a non-reflective paint. The occurrence of shadow flicker and blade glint from the Project and their potential impacts to nearby receptors are described in further detail in the LVIA (Appendix R).

8.6.6.2 Potential Impacts

Rotating WTGs can cause shadow flicker as the blades momentarily pass between the sun and the observer. In order for a WTG to cause shadow flicker the sun must be in the correct position in the sky to cast a shadow of the WTG, the WTG must be prevalent and pointing in a particular direction and there has to be an unobstructed line of sight between the WTG and the receptor (i.e. not obscured by clouds, screening etc). The locations affected by shadow flicker from WTGs varies with the time of day and time of year as the suns position is varied. Generally shadow flicker occurs to the east and west of the WTG structure or occasionally to the south if there is a significant height distance between the WTGs and the receptor (Figure 8-26). Apart from some people finding shadow flicker annoying, there is no evidence that there are any further health effects. The number of maximum hours a receptor can be exposed to shadow flicker by a wind farm development is regulated under NSW Planning Regulations.

Shadow flicker assessment included in the visual impact assessment (Appendix R) identified a total of two residences (ILG005 and UUN005) would potentially be affected by shadow flicker caused by the proposed WTGs. The theoretical shadow flicker modelling conducted at the site indicates that no dwelling in the vicinity of the Project is expected to exceed the annual 30-hr limit of shadow flicker experienced at dwellings recommended by the Visual Assessment Bulletin (DPE, 2016).

- ILG005 is an involved landowner. Potential shadow flicker is below the accepted max. 30 hours per year.

- UUN005 is an involved landowner with potential shadow flicker in excess of 100 hours per year.

Due to the isolated nature of the Study Area, there are a number of unsealed minor local roads close to the Site. The results of the shadow flicker analysis indicates shadow flicker may occur on small sections of Uungula Road and Illgingery Road. These roads have a low frequency of use and elements such as roadside vegetation would significantly reduce any potential shadow flicker along these roads. Further to this, with regards to potential shadow flicker impact on passing vehicles/motorists, the *Draft National Wind Farm Development Guidelines* state that "*there is a negligible risk associated with distraction of vehicle drivers who experience shadow flicker*". The effects of shadow flicker are similar to the phenomenon created when a vehicle in motion passes a static object e.g. travelling along a tree lined road. Therefore, shadow flicker impact on passing vehicles is not expected to be a problem for the Project.

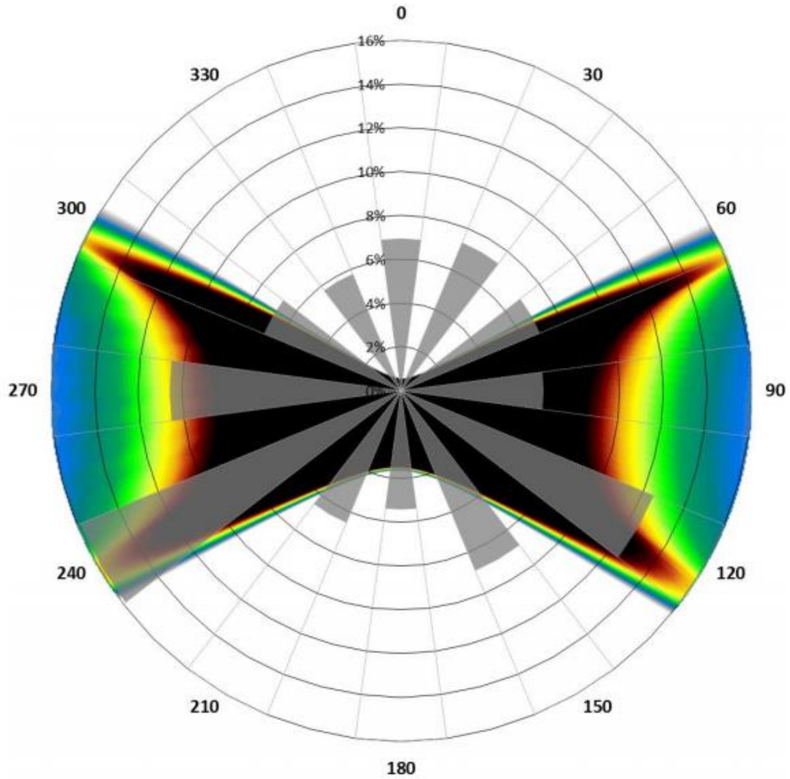


Figure 8-26: Indicative shadow flicker map and wind direction frequency distribution

The occurrence of reflection and blade glint from modern WTGs is comparatively low. The use of non-reflective paint, the orientation of the WTGs, concave surfaces of the blades and varying light conditions make it highly unlikely there would be any adverse impacts to surrounding receptors in terms of blade glint. In *Stirling McGregor v Tilt Renewables Australia Pty Ltd & Ors 2019* the findings of the South Australian ERD Court were not challenged and remain unaffected. These findings, which are relevant to other similar scale wind farm developments in Australia include: Shadow flicker levels in the *Draft National Wind Farm Development Guidelines* (30 hours per year theoretical, 10 hours per year actual) are the appropriate standard for assessing acceptable shadow flicker impact; and Blade Glint is not a problem for modern WTGs as blades are coated in non-reflective paint.

8.6.7 The Energy Storage Facility (ESF)

The Project incorporates an ESF which would (among other functions) enable electricity generated by the Project to be stored for later dispatch to the NEM. The SEARs require the Proponent to: *-Battery Storage – including a preliminary risk screening in accordance with State Environmental Planning Policy No. 33 – Hazardous and Offensive Development and Applying SEPP 33 (DoP, 2011) and if the preliminary risk screening indicates the development is "potentially hazardous", a Preliminary Hazard Analysis (PHA) must be prepared in accordance with Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis (DoP, 2011) and Multi-Level Risk Assessment (DoP, 2011).*

Some batteries are classified as a dangerous good according to the Australian Dangerous Goods Code (ADGC), whilst others remain unclassified despite their chemical constituents being classified separately. Battery types and potentially present hazardous materials for each battery type initially considered for the Project are provided in Table 8-34.

Table 8-34: Hazardous materials in the batteries, quantities on site and the classification of each good

Battery Option	Hazardous Material	UN Code	ADG Class	Quantity on Site (tonnes)	SEPP 33 Assessment Limit	Exceeds Screening Threshold?
Lithium-ion batteries certified to UN 34.80	Lithium-ion batteries	3480	9	-	No SEP33 assessment/ limit	No
Wet lead acid batteries	Batteries, wet, filled with acid, electrical storage	2794	8	-	No SEP33 assessment/ limit	No
Vanadium flow battery	Vanadium pentoxide, non-fused form	2862	6.1	-	No SEP33 assessment/ limit	No
Sodium Sulphur Battery	N/A	-	-	-	No SEP33 assessment/ limit	No
Sodium Hydride Battery	Sodium Hydride	1427	4.3	-	1 (SEPP33 Table 3)	Potentially
Nickel-Metal Hydride Battery	Nickel-Metal Hydride Batteries	3496	9	-	No SEP33 assessment/ limit	No
Cryogenic Storage	Dependant on cryogenic fluid	-	-	-	No SEP33 assessment/ limit	No
Compressed Air	N/A	-	-	-	No SEP33 assessment/ limit	No

Further assessment regarding the proposed storage quantities and methods would be required if the sodium hydride battery option were to be selected. As sodium hydride is not currently a commercially viable energy storage option, it is not necessary to undertake this assessment at present. Should this option be pursued further, a more detailed screening assessment (and potentially a subsequent PHA) shall be performed.

As a result of numerous factors (including functional and commercial), lithium-ion batteries are the most likely battery option for the Project, although this assessment provides flexibility in the technological choices, using a conservative assessment based on the most potentially hazardous of the battery options. The SEPP 33 screening process does not specify a screening threshold for ADGC Class 9 materials (Miscellaneous Hazardous material). As lithium-ion batteries are categorised as Class 9 goods, this battery option would not trigger a PHA based solely on the screening threshold. However, the SEPP 33 documentation is clear that the hazardous materials screening method will not be considered in isolation when determining whether an industry is considered potentially hazardous and would therefore require a PHA to be carried out (NSW DPE, 2011) prepared in accordance with *Hazard Industry Planning Advisory Paper No. 6 – Guidelines for Hazard Analysis* (DoP, 2011) and *Multi-Level Risk Assessment* (DoP, 2011) (refer to Appendix F for preliminary hazard assessment).

8.6.8 Bushfire and Electrical Fire

This section summaries the Bushfire Risk Assessment for the Project (Appendix U). The SEARs require the Proponent to: -

- *identify potential hazards and risks associated with bushfires / use of bushfire prone land, including the risks that a wind farm would cause bush fire and any potential impacts on the aerial fighting of bush fires and demonstrate compliance with Planning for Bush Fire Protection 2006 (if located on bushfire prone land);*

Section 100B of the *Rural Fires Act* requires that the Commissioner of the NSW RFS issue a *Bush Fire Safety Authority* (BFSA) for residential, rural residential or rural subdivision and special fire protection purpose developments on bushfire prone land. The Project is classified as SSD, but is not a subdivision for residential or rural residential purposes, nor is it a development for a special fire protection purpose, hence issue of a bush fire safety authority under section 100B of the Rural Fires Act is not required. Nonetheless, the Rural Fires Act places a duty of care on landowners or land managers to prevent fire spreading on and from their land, which is a principle that will be adhered to through all phases of the Project. As the Proposal could be exposed to bushfire risk from grasslands or nearby areas of vegetation, and carries the risk of a potential fire starting from within its boundary, a Bushfire

Risk Assessment (Appendix U) has been conducted in accordance with *Planning for Bush Fire Protection* (PBP), *A guide for councils, planners, fire authorities and developers 2006* (NSW RFS, 2006) and the improved measures provided in the PBP 2019, which accounts for lessons learnt in major bushfire events and changes in building codes and construction standards (NSW RFS, 2019). The analysis considers relevant guidance within NSW and considers potential fire hazards associated with the Site and surrounds in the existing environment and throughout the lifecycle of the Proposal. Finally, in line with the appropriate standards, it provides a coordinated response to fire risks with a range of mitigation strategies to provide the best possible protection outcome for the wind farm and surrounding local community. In accordance with relevant guidelines, consideration is given to human health and safety as well as potential interruption of existing services during the construction, operational and decommissioning phases of the Proposal. Fire could damage structures and impact the safety of employees and contractors at the Site. Fire leaving the Site poses a threat to human life, safety, and infrastructure and imperils native flora, fauna and ecosystems. Risk can be considered in terms of environmental hazards that increase the likelihood or severity of fire (vegetation, topography and weather patterns), as well as activities and infrastructure that increase combustion or ignition risks.

8.6.8.1 Existing Environment

The area surrounding the Project site is modified agricultural land utilised primarily for cattle, sheep and goat grazing, cropping for stock feed and sheep studs. The landscape is predominately modified grassland with scattered trees and isolated woodland as well as more extensive forested areas in closer proximity to some of the proposed infrastructure.

Fire Hazards

The Project Site is currently partially mapped Bushfire Prone Land Vegetation Categories 1 & 2 on Dubbo Regional Council's bush fire prone land map. Existing fire hazards on site include small areas of native vegetation and although managed, grazed pastures are also susceptible to grass fires in hot, dry and windy conditions. Bushfires occur in most years in this district, typically started by accidents such as escaped burns, carelessly discarded cigarette butts, machinery and hot works (e.g. welding and grinding). Lightning fires are uncommon. There are no ignition occurrence records for the site or nearby that provide statistical validity or a guide to likelihood of nearby ignition.

The fire-fighters likely to respond to a bushfire in this area would be volunteers from the Rural Fire Service and or individual property owners. If the wind farm is designated by Fire & Rescue NSW as major infrastructure, then brigades from Wellington town could respond. The risks to fire-fighter safety associated with a fire burning the WTGs and associated equipment include inhalation of potentially toxic fumes and smoke from any plastic components such as cables (although the main structure of the WTG will be steel or concrete/steel hybrid) or other decomposed products (Allianz Risk Consulting, 2012). All NSW Fire and Rescue stations are equipped with the resources and trained personnel required to deal with fire (and hazmat incidents). Direct access to the Site is via a proposed new access that connects to Twelve Mile Road. There will also be new internal access tracks constructed to facilitate heavy vehicle access between the proposed towers and Ancillary Infrastructure. These roads can effectively provide emergency vehicle entry and emergency evacuation routes in the event of a bushfire at the site. Existing assets at risk from fire include various agricultural crops, livestock (sheep & cattle), fences and residences. The closest town is Wellington which is located approximately 14 km to the west of the Site.

8.6.8.2 Potential Impacts

Fire could damage infrastructure and impact the safety of employees and contractors at the Site. Fire leaving the Site poses a human safety and property threat and imperils native flora, fauna and ecosystems. Construction materials for the WTGs are steel or concrete or steel hybrids for the main sections and the blades are fibreglass. The potential for fire of WTGs is inherently low (CFS, 2016). The Country Fire Authority (CFA) (2015) identified a risk of fire as a result of electronics and combustible oils and hydraulic fluids in the same enclosure. It is intended that a 10 m APZ will be created around the WTGs and the vegetation fuel around the WTGs, overhead transmission lines and access roads will be routinely maintained in a low fuel state by organic (i.e. grazing), mechanical, manual and chemical clearing methods. Establishment of an APZ will be undertaken prior to construction activities commencing and as part of ongoing maintenance activities for the duration of the Project. While an APZ would assist with wind farm infrastructure protection, a fire could still spread in this fuel under severe fire weather conditions. Each of the proposed new components of the Project, including towers, wind monitoring masts and operational and maintenance components, are at risk from fire damage should a bushfire propagate within the wind farm, or from an external fire threat. Woodland fragments are sparse across the Site and will be retained in areas not developed for the Project as detailed in Section 8.4. Due to the construction and operational activities occurring outside the more densely treed areas, it is considered unlikely the Project will pose a significant bushfire risk. Although cleared areas of the Site are not currently mapped as bushfire prone land, grassland fires burn at a higher intensity and spread more rapidly with a shorter residence time than that of fires in other vegetation classifications (RFS, 2018).

Construction and decommissioning

Potential ignition sources during the construction and decommissioning phases of the Project would include:

- Machinery movement in long grass;
- Hot work activities, including welders and grinders;
- The storage of waste and combustible materials onsite;
- Storage of flammable liquids;
- Cigarette butts disposed of carelessly on-site and from cars travelling along roads;
- Electrical faults;
- The ESF; and
- Lightning strikes.

Earth moving equipment, power tools (e.g. welders, grinders), mowers and slashers are well known for starting bushfires under conditions of high temperature, low humidity and high wind. Therefore, construction and ongoing maintenance of the wind farm will be a potential source of ignitions from December to March. A technical report into the financial and market impacts of WTG fires (Sharma, 2015) found that WTG fires are relatively infrequent, with approximately around 50 each year out of 300,000 WTGs internationally (a rate of 1:6000). Considering the sparse vegetation cover within the Development Corridor and other factors discussed above, it is considered unlikely that the construction or decommissioning of the Project would pose a significant bush fire risk. The bush fire hazard associated with the activities listed above is considered highly manageable through staff and contractor consultation and awareness programs, electrical equipment selection, appropriate access arrangements, fuel load reduction programs, safety protocols during periods of high fire risk and the implementation of an emergency response plan as detailed below in proposed mitigation measures. Potential fire risk during decommissioning activities would be the same to those for construction.

Operation

The potential for fire originating from an ESF will be assessed in detail post-approval. It is conceivable that arcs or melted components resulting from a fault could ignite grass fuels under or surrounding installations and start a bushfire. However, the level of risk from faults cannot be assessed at this stage because there is no case history available and it is not possible to compare the ignition risk from farm operations (e.g. crop harvesting) relative to wind farm operation. With appropriate mitigation strategies in place, as discussed below, bushfire and electrical fire risks during the operation of the wind farm are considered highly manageable.

8.6.9 Blade Throw

This section describes Blade Throw risk zone results for the proposed WTG specifications and cross-references these to existing environmental conditions to identify potential environmental hazards indirectly associated with Blade Throw. The SEARs require the Proponent to: -assess blade throw risks, including potential interactions with battery storage.

8.6.9.1 Existing Environment

The *DPE Wind Energy Guideline – for state significant wind energy development 2016* and the *DPI NSW Planning Guideline wind farms 2011 (draft)* instruct that the risk of 'blade throw', involving a WTG blades breaking or being ejected during operation, should be considered when assessing the potential safety hazards from wind farm developments. Relevant considerations may include (but are not limited to):

- whether the proposed WTGs are certified against relevant standards such as IEC 61400-23;
- WTG systems – Part 23: Full-scale structural testing of rotor blades or other equivalent standards; evidence of any such certification should be provided;
- overspeed protection mechanisms including 'fail safe' mechanisms (e.g. back up (battery) power in the event of a power failure);
- operational management and maintenance procedures including any regular maintenance inspections;
- provisions for blade replacement in the event a blade fault is identified (e.g. during a periodic inspection);
- the separation distance between WTGs, neighbouring dwellings and property boundaries;
- the probability of blade throw occurring; and
- the location of battery storage facilities and their likelihood to be damaged by potential blade throw.

8.6.9.2 Potential Impacts

Blade throw is a potential public safety hazard involving a rotor blade dropping or being thrown from the WTG structure. In extremely rare incidents, either from improper design, manufacturing or installation has combined with strong wind gusts exceeding the design load of the WTG structure, WTG blades have collapsed and fallen from the tower. Modern WTGs are designed in accordance with international engineering standards *International Electrotechnical Commission 61400* (IEC 61400) which include ratings for extreme weather events and hurricane strength winds. IEC 61400 is a set of design requirements made to ensure that WTGs are appropriately engineered for potential damage from natural hazards such as hurricane force winds and lightning strike.

Blade throw impacts have been considered using the WTG dimensions of 170 m in diameter and towers up to 250 m from ground to tip of blade.

Construction Phase - Direct and Indirect Impacts

The WTG blades will be delivered to site securely via articulated truck. The risk of blades dislodging from trucks during haulage to site and during placement is minimal. The blades will be lifted via crane to the hub and secured to industry best work practice. Work shut down procedures will be followed in event of winds exceeded the safe use threshold of the crane. The contractor during construction will adopt internationally endorsed and certified quality management system. A Quality Control procedure will be followed to track each blade from pre-manufacture of components to erection and testing pre commissioning. All components of the WTGs will be certified as meeting current best practice manufacturers testings pass level. Upon delivery all components will be inspected for any flaws, defects or inconsistencies in quality. Any component not meeting industry best standards will be rejected. Once installed all components will be inspected and tested by industry certified practitioners independent of the construction company and parent company.

Operation Phase - Direct and Indirect Impacts

Operation of the WTGs will be in accordance with current best practice. Inspection and Testing Procedures (ITPs) will be initiated and followed and audited during the construction and commissioning phase. Once all testing finds all WTG components including the blades are passed, the WTG will be commissioned for operation.

During WTG operation regular maintenance inspections off all components will be undertaken and reparative activities will be in accordance with the manufacturer's recommendations. Blades will be inspected for micro cracks using current best practices. If any cracks above engineering thresholds are detected, the WTG will be immobilised until a replacement blade can be installed. The WTGs will be installed with automatic shutdown governors, triggered by pre-programmed wind speed (e.g. 30 km/hr). This trigger shuts down and alters the blades pitch so as to not be caught by the wind, losing aerodynamic properties and preventing spin. The operation of the WTGs will be connected via telemetry to a central control hub via sensors which, if a failsafe is triggered, will override the system to shut the WTG down. These sensors will be able to detect any wobble deflection in the hub, blade or WTG housing indicating mechanical instability and will shut the system down before structural failure occurs and potentially leads to blade throw. The locations of any battery storage facilities must be carefully considered by the Proponent, as blade throw has the potential to cause catastrophic failure within these facilities. Entire blades and blade fragments have the potential to pierce and disrupt battery systems, which depending on the battery type, can cause combustion and/or explosive reactions.

Risks

Blade throw has occurred on similar projects. EDP renewables (2005) have analysed some 20,000 WTG towers in Europe and the Americas, finding the chance per annum of blade throw at any given time (yearly) is approximately 0.0008%. This is considered a very rare occurrence. The risk of an occurrence is further minimised through adoption of industry best management practices and regulatory quality assurance systems. International experience to date has indicated very low risk associated with tower collapse, components falling from towers, ice throw, and blade throw.

Modelling of Blade Throw

Extensive literature reviews on blade throw indicate that there are many approaches to modelling blade throw potentials, whether theoretical or incident based. This is likely due to the complexity of the analysis, coupled with the extremely low incidence of blade throws reported. Despite this, there is strong similarity in results from both predictive and incidence-based studies providing a robust and reliable framework within which to estimate blade throw and safety risk.

Hazard Zone Distance Assessment

Modelling conducted for a similar scale wind energy project such as the Wild Horse Wind Power projects (EDP renewables, 2005) presents a simplified worst case scenario, where loss of a whole blade would occur with the blade rotating at maximum speed when oriented at 45^{o} from the horizontal axis and rising. This is the maximum trajectory case from standard texts as illustrated below (Figure 8-27). This data indicates that for the maximum WTG failure, blade throw distance is approximately the height of the entire WTG at blade tip height. For example, if the blade tip height is at the worst-case upper tip height of 250 m, the distance a blade is likely to land once thrown is 250 m away from the tower. If the blade acts as a sail/wing or a downward slope falls away from the tower the distance of landing would be greater; thus, a blade throw buffer zone of 500 m around the tower is recommended.

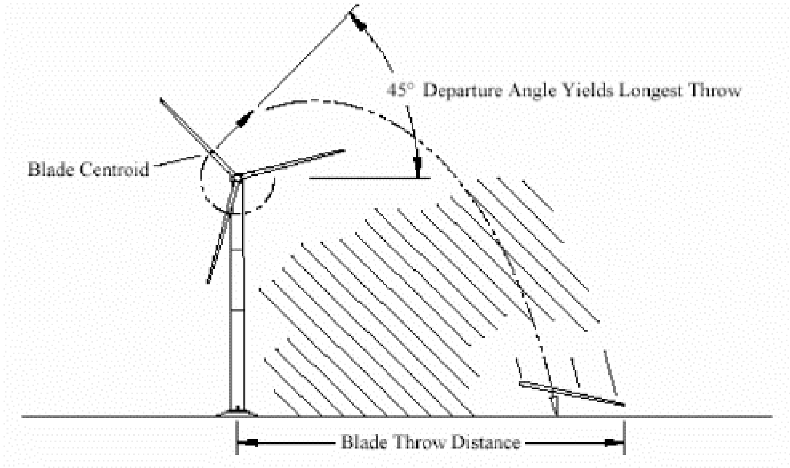


Figure 8-27: Blade throw distance (EDP Renewables, 2005)

Blade fragments throw, where the blade is damaged (such as by lightning strike bird impact) and break apart has also been estimated through use of a dynamic model of blade failure and Monte Carlo simulation techniques (Rodgers *et al*, 2011). Using three WTG models this study found that theoretical blade fragments throws of up to approximately 530 m for a 3 MW WTG can occur (Rodgers *et al*, 2011). Cotton (2007) estimated impact probabilities at a wind farm site by comparing two methodologies based upon mathematical modelling techniques and risk contours, where blade throw distances were found to range between 155 m – 205 m from the tower. In order to model worst case impact, wind speeds equivalent to 1 in 50 year (2% AEP) events were used and very small blade fragments were considered (10% by surface area/weight). Under these conditions the risk is a 1% chance of a fragment thrown a distance up to 1.5 km. Risk of WTG blade failure and throw reported in a Dutch incident handbook have also been researched (Kammen, 2003). The maximum reported throw distance documented was found to be 150 m for an entire blade and 500 m for blade fragments (Chief Medical Officer of Health, 2010). These distances correlate with other modelled and predicted blade throw distances. According to Braam *et al.* (2005) referenced in the Chief Medical Officer of Health's report (2010), the risk of blade failure (including non-throw events) ranges from 1 in 2,400 to 1 in 20,000 WTGs per year (depending on make and quality of manufacture). Regarding the Project Site, the closest non-involved and occupied resident is 2 km away, while the closest involved and occupied resident is 849 m away. The closest neighbouring property boundary is approximately 72 m from the nearest WTG location (subject to micrositing). Based on the statistics referenced the chance of a blade and/or a fragment impacting on an occupied residence is extremely low, at 0.0008%.

Probability Assessment

Probability of occurrence is critical to blade throw analysis. The probability associated with the Hazard Zone Distance scenarios modelled for other similar scale projects such as the Wild horse Wind Power project (EDP renewables, 2005) provides a rational basis for assessing the risks of WTGs within their surrounding environment. The table below provided the frequencies of occurrence of each described event (tower collapse) blade fragmentation and blade throw from analysis of incidences reported in German, Danish and Dutch data bases.

Scenario	Probability (1/year)
Collapses of entire tower from base	3.2×10^{-4}
Loss of entire blade	8.4×10^{-4}
Loss of blade fragment	2.6×10^{-4}

8.7 Aboriginal Cultural Heritage

8.7.1 Introduction

NSW Archaeology Pty Ltd undertook an Aboriginal Cultural Heritage Assessment (ACHA) for the Project in 2018. The assessment report (ACHAR) is provided in Appendix J, and is summarised below. The assessment was undertaken to address the project SEARs for Aboriginal Cultural Heritage as listed below, (also applicable to the Historic Heritage section):

- Assess the impact on Aboriginal cultural heritage (including archaeological and cultural) in accordance with the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* (OEH 2011) and *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (DECCW 2010).
- Provide evidence of consultation with Aboriginal community in determining and assessing impacts, developing options and selecting option and mitigation measures (including the final proposed measures) having regard to the *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW 2010).
- Assess the impact on historical heritage having regard to the *NSW Heritage Manual*.
- The EIS must identify and describe the Aboriginal cultural heritage values that exist across the whole area that will be affected by the Uungula Wind Farm and describe these in an ACHAR. This may include the need for surface survey and test excavation. The identification of cultural heritage values must be conducted in accordance with the *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* and guided by the *Guide to investigating, assessing and reporting on Aboriginal cultural heritage in NSW* and consultation with OEH (now DPIE) regional officers.
- Where Aboriginal cultural heritage values are identified consultation with Aboriginal people must be undertaken and documented in accordance with the *Aboriginal cultural heritage consultation requirements for proponents 2010*. The significance of cultural heritage values for Aboriginal people who have a cultural association with the land must be documented in the Uungula Wind Farm ACHAR.
- Impact on Aboriginal cultural heritage values are to be assessed and documented in an ACHAR. The ACHAR must demonstrate attempts to avoid impact upon cultural heritage values and identify any conservation outcome. Where impacts are unavoidable the ACHAR must outline measures proposed to mitigate impacts. Any objects recorded as part of the assessment must be documented and notified to OEH.

Project Specific Requirements:

- D. Where the Project's footprint occurs in areas identified by the EIS as sensitive ACH areas, surface surveys must be undertaken by a qualified archaeologist to determine the presence or absence of Aboriginal objects and the significance of those objects. The result of the surface survey is to inform the need for targeted subsurface test excavation to better assess the integrity, extent, distribution, nature and overall significance of the archaeological record. The results of surface surveys and test excavations undertaken at this stage are to be documented in the EIS
- E. Where the Project's footprint is unknown at the submission of the EIS, point D above applies if the future footprint occurs in areas identified by the EIS as sensitive ACH areas
- F. The EIS must outline procedures to be followed if Aboriginal objects are found at any stage of the life of the Uungula Wind Farm to formulate appropriate measures to manage unforeseen impacts
- G. The EIS must outline procedures to be followed in the event Aboriginal burials or skeletal material is uncovered during construction to formulate appropriate measures to manage the impacts to this material.

Austral Archaeology (Austral) were commissioned in 2019 to prepare an addendum to the ACHAR. The assessment report is provided in Appendix K and is summarised below. This addendum was required to be complimentary to the ACHAR previously prepared by NSW Archaeology. A revised set of SEARs (SSD 6687) for the overall project were issued on 11 November 2019. Those relevant to Aboriginal Cultural Heritage are:

- assess the impact on Aboriginal cultural heritage impact (archaeological and cultural) in accordance with the *Guide to Investigating, Assessing and Reporting on Aboriginal Cultural Heritage in NSW* (OEH, 2011) and the *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW* (DECCW, 2010);
- provide evidence of consultation with Aboriginal communities in determining and assessing impacts, developing options and selecting options and mitigation measures (including the final proposed measures), having regard to the *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010* (DECCW, 2010); and
- assess the impact on historic heritage having regard to *the NSW Heritage Manual*.

The ACHAR and Addendum Archaeological Survey Reports are based on the legal requirements, guidelines and policies of the Heritage Team of the Department of Premier and Cabinet (DPC), formerly the OEH, and the Department of Environment, Climate Change and Water (DECCW). A process of Aboriginal community consultation has been undertaken in accordance the NSW OEH's *Aboriginal cultural heritage consultation requirements for proponents 2010* (DECCW, 2010). The assessments have sought to identify and record Aboriginal cultural areas, objects or places, assess the archaeological potential of the proposal area and formulate management recommendations based on the results of the community consultation, background research, field survey and a significance assessment.

Detailed mitigation and management measures are provided in Appendix J and Appendix K, and are summarised in Environmental Management (Section 9) as Statement of Commitment AH001.

8.7.2 Existing Environment

The Aboriginal Heritage Management Information System (AHIMS) is a database maintained by DPIE and regulated under section 90Q of the NPW Act. AHIMS holds information and records regarding the registered Aboriginal archaeological sites (Aboriginal objects, as defined under the Act) and declared Aboriginal places that exist in NSW.

Two extensive searches of the AHIMS database were conducted on 31 March 2020 (Search ID 494795) and 1 April 2020 (Search ID 494986) to cover the entire assessment area to identify if any registered Aboriginal sites were present within, or adjacent to, the study area. The AHIMS database search was conducted within the following parameters:

Search Parameters	(ID 494795)	(ID 494986)
GDA Zone	55	55
Eastings	692000 - 722000	722100 - 731000
Northings	6385000 - 6415000	6385000 - 6415000
Buffer	50m	50m

The AHIMS searches each identified 84 Aboriginal sites recorded, giving a total of 168 recorded Aboriginal sites and no Aboriginal places. Following further spatial analysis, 10 of these were identified as occurring within the Development Footprint, and two within the vicinity of the Development Footprint (Table 8-35 and Figure 8-28).

Table 8-35: Location of AHIMS sites within search area

Relevance	Site ID	Site Name	Datum	Description
Within Development Footprint	36-5-0170	UWF SU 22/ L1	GDA	Artefact
	36-5-0171	UWF SU 24/ L1	GDA	Artefact
	36-5-0172	UWF SU 26/ L1	GDA	Artefact
	36-5-0173	UWF SU 30/ L1	GDA	Artefact
	36-5-0175	UWF SU 34/ L1	GDA	Artefact
	36-5-0179	UWF SU 44/ L1	GDA	Artefact
	36-5-0180	UWF SU 44/ L2	GDA	Artefact
	36-5-0181	UWF SU 44/ L3	GDA	Artefact
	36-5-0182	UWF SU 44/ L4	GDA	Artefact
	36-5-0183	UWF SU 46/ L1	GDA	Artefact
Within vicinity	36-5-0174	UWF SU 32/ L1	GDA	Artefact
	36-5-0184	UWF SU 49/ L1	GDA	Artefact

Searches have been conducted of the NSW State Heritage Register and the Australian Heritage database. No Aboriginal heritage sites are listed on these databases as being within the Project Site.

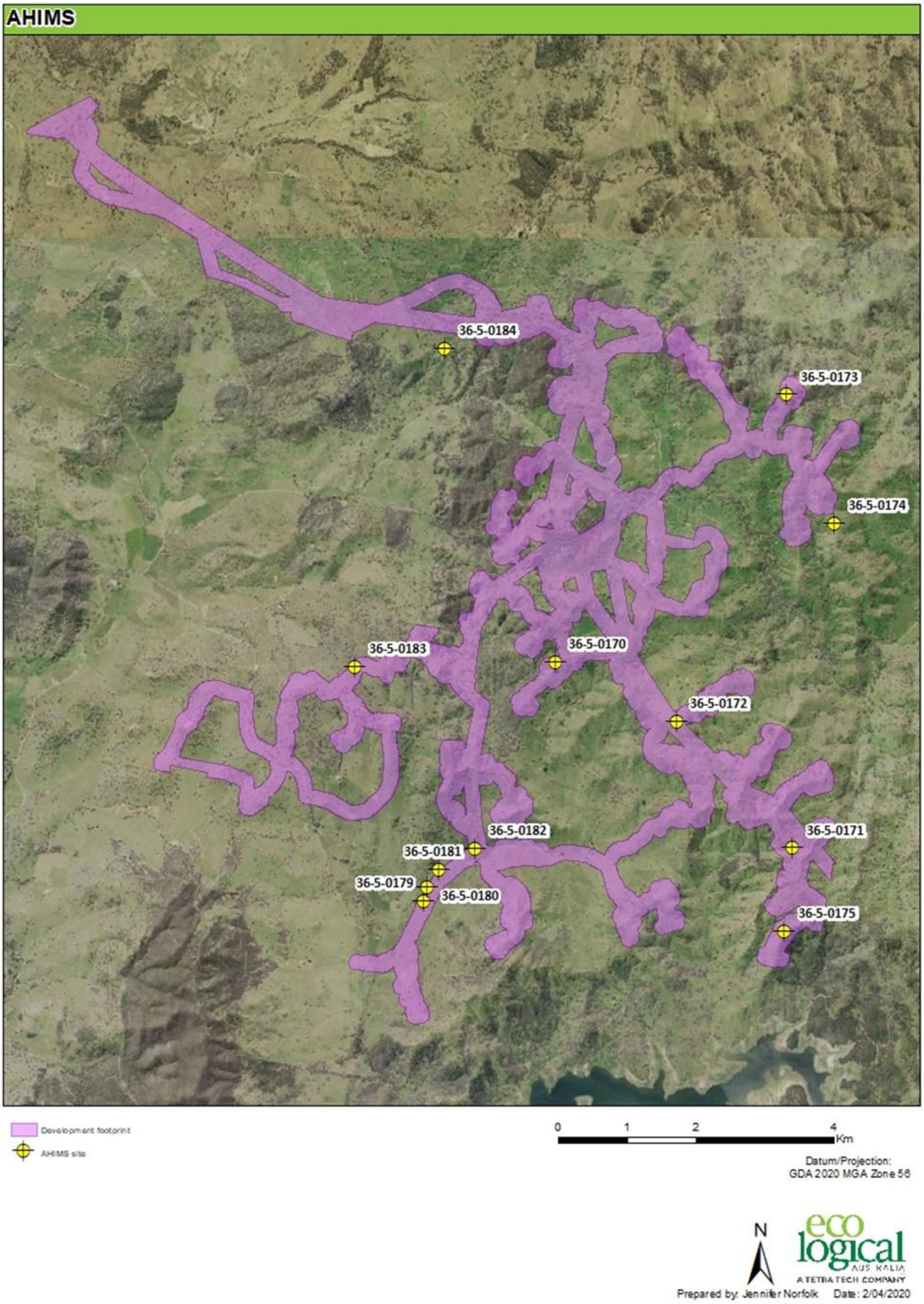


Figure 8-28: Registered AHIMS sites in relation to the Development Footprint

8.7.2.1 Existing Assessments

NSW Archaeology – Aboriginal Cultural Heritage Assessment (2018)

A field assessment was conducted by NSW Archaeology Pty Ltd with representatives from the Registered Aboriginal Parties. The practical methodology for the field survey entailed a pedestrian traverse of a representative sample of the proposed activity areas. The field survey was aimed at locating Aboriginal objects. An assessment was also made of prior land disturbance, survey coverage variables (ground exposure and archaeological visibility) and the potential archaeological sensitivity of the land.

A previous survey conducted in 2012 (NSW Archaeology) identified 26 artefact sites across the survey units, during the 2018 survey a further 25 artefact sites were identified.

NSW Archaeology recorded the process of community consultation conducted in a previous assessment undertaken in 2012 in accordance with the Consultation Requirements. The Registered Aboriginal Parties identified in the 2012 assessment were contacted by NSW Archaeology in 2018 to participate in the Aboriginal Cultural Heritage Assessment for the study area.

ACHAR findings are:

- That there were no identified Aboriginal cultural and archaeological heritage constraints relating to the proposal.
- The majority of Aboriginal object sites recorded were found to be outside areas of the proposed impacts.
- The proposed impacts to the archaeological resource was considered to be minor and discrete in nature and would occupy a relatively small footprint in the surrounding environment. The archaeological resource in the broader area (those areas which lie outside actual proposed impacts) will not sustain any impacts as a result of the proposal.

Based on a consideration of the small and discrete nature of proposed impacts and the identified archaeological and cultural values, NSW Archaeology did not warrant subsurface test excavation.

- The level of assessment achieved during the field survey was considered to have been adequate for the purposes of determining the cultural and archaeological status of the proposal area. Furthermore, the majority of impact areas are eroded to bedrock and do not possess soil profiles which might host subsurface archaeological deposits; and

- As a result of preliminary discussions with the Registered Aboriginal Parties for the project, a program of salvage excavation in one survey unit adjacent to Uungula Creek should be given consideration as an appropriate form of impact mitigation.

Austral Archaeology – Addendum Archaeological Survey (2019)

Addendum Archaeological Survey (2019)

The Development Corridor was altered in 2019 with additional areas not being covered by the initial assessment undertaken by NSW Archaeology in 2018. An Addendum archaeological survey of the additional study areas was undertaken from 28 October until 1 November 2019 by Alexander Beben and Neil Fenley of Austral Archaeology, Bradley Bliss of Wellington Valley Wiradjuri Aboriginal Corporation, Helena Stanley of Wellington Local Aboriginal Land Council, Brendan Doherty and Fleur Magick Dennis of Gallangabang Aboriginal Corporation. A further survey was undertaken to clarify these results from 11 December through to 13 December 2019 by Neil Fenley and Hayley Hunter of Austral Archaeology, Steven 'George' Flick of Murong Gialinga, and Jamie Williams of the Mudgee Local Aboriginal Land Council.

Austral Archaeology acknowledged the assistance from six Registered Aboriginal Parties in the Addendum Survey for the Project. The Registered Aboriginal Parties were provided the draft addendum survey report for comment.

This pedestrian survey assessment process resulted in the identification of a further 115 stone artefacts across 28 new Aboriginal site locations. Austral also identified seven new areas of high and moderate potential archaeological deposits (PADs) recorded in five of the new survey areas. Based on the quantity and location of the newly identified sites and PADs, the Development Footprint is considered to have high potential to impact on Aboriginal objects.

Addendum Survey findings:

Identified 28 new Aboriginal sites and seven areas of potential archaeological deposit within the proposed development footprint, the survey report did not identify if any Aboriginal artefact sites recorded during 2012, 2018 and this current assessment might be impacted by the proposed works.

The addendum survey report identified that if it was not possible to realign or reposition certain infrastructure as detailed in Table 9, Figure 20, Figure 21, Figure 22, Figure 39, Figure 40 and Figure 41 (Appendix J) then it would be necessary to undertake subsurface testing in those areas where impacts will affect the archaeological resources present. This applied to the following areas;

- Survey Area 6 - has two small artefact scatters and a PAD which would be impacted by the proposed Development Footprint and are within the Development Corridor.
- Survey Area 11 - which has five artefact scatters and two large PADs, these would be directly impacted by the proposed Development Footprint and are within the Development Corridor.

Survey Area 24 - has a single artefact scatter and PAD directly in line with the proposed Development Footprint and are within the Development Corridor

8.7.3 Potential Impacts

The potential impacts on Aboriginal cultural heritage items and places posed by the proposed development of the study area include:

- Direct impact to Aboriginal items and/or places within the Development Corridor as a result of:
    - WTG installation, connection, maintenance and construction activities;
    - modifications to the landscape relating to ancillary infrastructure; or
    - modifications to the landscape relating to access track construction and/or existing road upgrades; and

- Indirect impact to Aboriginal items and/or places within the identified work zones as the result of altered vegetation structures and/or altered wind/water movement.
- An impact assessment is set out below in Table 8-36 below. Most heritage evidence is highly valued by Aboriginal people given its symbolic embodiment and physical relationship with their ancestral past. The archaeological significance of the recorded Aboriginal artefact locales in the project area is set out in Table 8-36 below.

The Registered AHIMS sites identified by NSW Archaeology and newly identified sites by Austral Archaeology that are located within and adjacent to the Development Corridor (Figure 8-28) are listed in Table 8-35.

Table 8-36: Impact assessment of Aboriginal object locales within the Development Corridor

Aboriginal object locale/Site Number	Significance	Type of harm	Degree of harm	Consequence of harm
AHIMS ID 36-5-0170/ UWF SU22/L1	Low	Direct	Total	Total loss of value
AHIMS ID 36-5-0171/ UWF SU24/L1	Low	Direct	Total	Total loss of value

Aboriginal object locale/Site Number	Significance	Type of harm	Degree of harm	Consequence of harm
AHIMS ID 36-5-0172/ UWF SU26/L1	Low	Direct	Total	Total loss of value
AHIMS ID 36-5-0173/ UWF SU30/L1	Low	Direct	Total	Total loss of value
AHIMS ID 36-5-0175/ UWF SU34/L1	Low	Direct	Total	Total loss of value
AHIMS ID 36-5-0179/ **UWF SU44/L1**	Low	Direct	Total	Total loss of value
AHIMS ID 36-5-0180**/** **UWF SU44/L2**	Low	Direct	Total	Total loss of value
AHIMS ID 36-5-**0181/** **UWF SU44/L3**	Low	Direct	Total	Total loss of value
AHIMS ID 36-5-0182/ **UWF SU44/L4**	Low	Direct	Total	Total loss of value
AHIMS ID 36-5-0183**/** **UWF SU46/L1**	Low	Direct	Total	Total loss of value
AHIMS ID 36-5-0184/ **UWF SU49/L1** AHIMS ID 36-5-0174/ **UWF SU32/L1**	Low	None	None	No loss of value
AHIMS ID pending/ **UWF12M_AS1**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWF12M_IF1**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA2_AS2**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA6_AS1**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA6_AS2**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA7_IF1**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA9_AS1**	Low	Possible	Total	Partial loss of value

Aboriginal object locale/Site Number	Significance	Type of harm	Degree of harm	Consequence of harm
AHIMS ID pending/ **UWFSA11_AS1**	High	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA11_AS2**	High	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA11_AS3**	Moderate	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA11_AS4**	Moderate	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA11_AS5**	Moderate	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA11_IF1**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA11_IF2**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA11_IF3**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA11_IF4**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA11a_IF1**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA11a_IF2**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA12_AS1**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA22_IF1**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA22_IF2**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA22_IF3**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA22_IF4**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA22_IF5**	Low	Possible	Total	Partial loss of value

Aboriginal object locale/Site Number	Significance	Type of harm	Degree of harm	Consequence of harm
AHIMS ID pending/ **UWFSA24_AS1**	Moderate	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFSA24_IF1**	Low	Possible	Total	Partial loss of value
AHIMS ID pending/ **UWFAS1**	Low	Possible	Partial	partial loss of value
7 areas of PAD	Unknown	Possible	Unknown	Unknown**

*Partial loss of value is assumed as Austral have recommended either surface collection of test excavation for these sites. The context of the sites will be lost however the object will be recovered and therefore partial value will be retained.

**significance and consequence of harm subject to further investigation (as detailed in recommendations)

The DPIE Aboriginal Heritage Unit aims to ensure impacts to Aboriginal objects and places are avoided or reduced and that where possible Aboriginal sites should be conserved. The guiding principle is that, wherever possible, avoidance should be the primary management option, but if avoidance is not feasible, measures shall be taken to mitigate against impacts to Aboriginal items and/or places.

NSW Archaeology ACHA conclusion and recommend

- There are no identified Aboriginal archaeological and cultural constraints;
- The recorded Aboriginal object locales which would be impacted are assessed to be representative of a very low-density distribution of stone artefacts. The archaeological heritage significance of these locales is assessed to be low. Accordingly, unmitigated impact, where this would occur, is considered to be appropriate. A management strategy of impact avoidance is not warranted;
- Nevertheless, it is recommended that ground disturbance impacts associated with the proposal be kept to a minimum and to defined areas so as to ensure as little impact as possible to the Aboriginal objects (stone artefacts) which can be expected to extend in a relatively continuous, albeit very low density distribution across the broader landscape encompassed by the proposal;
- It is recommended that when the design is finalised, additional archaeological assessment is conducted in any areas which are proposed for impacts that have not been surveyed during the current assessment;
- The proponent should, in consultation with an archaeologist, develop a CHMP, which documents the procedures to be followed for impact mitigation and management. The development of an appropriate CHMP should be undertaken in consultation with an archaeologist, the Registered Aboriginal Parties and the NSW BCD within DPIE. It would aim to provide clear guidance as to

allowable impacts and to ensure the effectiveness and reliability of mitigation and management strategies which may include salvage excavation, if required. The CHMP would set out the procedures to be adopted in the unlikely event that human remains or unexpected Aboriginal objects are found during construction;

- The proponent should ensure that Aboriginal Site Impact Recording Forms are completed (and submitted to the NSW BCD within DPIE) for each Aboriginal object site harmed during construction of the wind farm.

Austral Archaeology Survey Report recommendations

It is recommended that areas which have surface artefacts, sites or PADs present be avoided if possible, this will allow works to be undertaken without further cultural heritage procedures needing to be undertaken. However, if it is not possible to avoid these areas (to realign or reposition certain infrastructure as detailed in Table 9, Figure 20, Figure 21, Figure 22, Figure 39, Figure 40 and Figure 41 of Appendix K) the following procedures, to be undertaken before any construction works are commenced, are recommended in those areas where impact will affect the archaeological resources present.

- The individual finds - A community collection followed by an analysis of the retrieved artefacts;
- The low significance artefact scatters - A community surface collection followed by an analysis of the retrieved artefacts would be appropriate;
- The moderate and high significance artefact scatters - A program of subsurface testing be undertaken at the sites to establish the site density and boundaries followed by an analysis of the retrieved artefacts; and
- The PADs - A program of subsurface testing to establish the presence or absence of artefactual material within these areas followed by an analysis of the retrieved artefacts.

The necessity to undertake subsurface testing particularly applies to the following areas:

- **Survey Area 11** Which has five artefact scatters and two large PADs, these would be directly impacted by the proposed works;
- **Survey Area 24** Has a single artefact scatter and PAD directly in line with the proposed works footprint; and
- **Survey Area 6** Has two small artefact scatters and a PAD which would be impacted by the works.

Once the subsurface testing is completed and the results of this analysed it may then be necessary to follow on with salvage excavations of any sites that are present and likely to be impacted by the Development Footprint or Development Corridor.

8.8 Historic Heritage

Concerns regarding historic heritage were not raised during community consultation. The Project avoids impacts to historic heritage through design. Mitigation measures are identified to manage unexpected excavation of historic material. Mitigation and management measures are provided in Environmental Management (Section 9) as Statement of Commitment HH001.

8.8.1 Introduction

The historic heritage assessment was undertaken in accordance with the *NSW Heritage Manual* (NSW Heritage Office & NSW Department of Urban Affairs and Planning, 1996), specifically the guidelines *Assessing Significance for Historical Archaeological Sites and 'Relics'* (Heritage Branch Department of Planning, 2009), and with reference to the Burra Charter (the Australian ICOMOS Charter for Places of Cultural Significance) (ICOMOS (Australia), 2013).

The primary objectives of the historical heritage assessment were: -

- To identify, through heritage register searches, historical research and targeted archaeological investigations, the historical heritage values of the land within the Project Site;
- To assess the significance of potentially impacted historic heritage items in accordance with the NSW Heritage Branch guidelines: Assessing Heritage Significance (NSW Heritage Office, 2001); and
- To provide, on the basis of significance and impact assessments against the Project, appropriate management and mitigation strategies for all identified and potential historic heritage items.

This involved the following key tasks:

- A search of relevant historic heritage registers, databases and lists, including: -
    - World Heritage List (WHL);
    - National Heritage List (NHL);
    - Commonwealth Heritage List (CHL);
    - Register of the National Estate (non-statutory archive);
    - NSW Heritage Database (non-statutory);
    - NSW State Heritage Register;
    - NSW State Heritage Inventory; and
    - Wellington LEP 2012 Heritage Schedule.
- Background research concerning land within, and in the vicinity of the Project Site in order to identify historic heritage items;

- Comprehensive field survey of the Project Site to identify potential historic items;
- Identify potential direct and indirect impacts to historic items; and
- Undertake a significance assessment for potentially impacted items in accordance with the guidelines *Assessing Heritage Significance* (NSW Heritage Office, 2001) to establish why a particular site or item is of significance and, if necessary, to enable appropriate mitigation strategies to be developed.

8.8.2 Existing environment

8.8.2.1 Australian Heritage Database

A search of this database revealed that there are no heritage items within the Project Site listed on the Australian Heritage Database.

8.8.2.2 Wellington Local Environment Plan

A search of the Wellington LEP 2012 revealed that while there are various items listed as historic heritage of local significance within 5 km of the Project Site, there are no heritage items currently listed within the Project Site (Figure 8-29; Table 8-37).

Table 8-37: Local heritage results within the Wellington LGA

Item No.	Class	Item Name	Significance
I76	Dwelling	"Glenwood Homestead" 2250 Twelve Mile Road, Spicers Creek	Local
I158	Species	*Zieria obcordata* (threatened plant species)	Local

Figure 8-29: Location of historic heritage items identified in the Wellington LEP

8.8.2.3 Historic Survey Results

Austral Archaeology identified an excavated shaft, set approximately 15 metres north of the main creek line in Survey Area 19 (Appendix K). This had large stones forming a collar above rounded logs placed in the shaft. It was estimated to be less that ten metres deep with water at the bottom. The purpose of this shaft is unknown, however there were no other shafts noted in this region and for that reason it was presumed to be a well rather than a mine. Austral Archaeology conclude that the structure may be of historical significance and recommend recording before works proceed. However, no works are proposed within Survey Area 19, although, it is located within the Development Corridor.

No historic other heritage items or relics were recorded in the Project Site.

8.8.3 Potential Impacts

While there are several heritage items within the surrounding area, they are considered to be at a distance to the Project Site. Furthermore, no items of local historic significance have been identified within the Project Site and Disturbance Footprint.

Potential impacts on identified historic heritage items are described in Table 8-38 below.

Table 8-38: Potential impacts on local heritage results (Wellington LEP 2012)

Item Name	Curtilage distance from		Potential Impacts
	The Site	Development Corridor	
"Glenwood Homestead" 2250 Twelve Mile Rd, Spicers Creek	1.9 km	3.8 km	Low - potential visual impacts from grounds.
Zieria obcordata (threatened plant species)	1.2 km	1.2 km	Nil

The above desktop assessment of potential impacts has identified two areas of low sensitivity within the area. No sensitive areas were identified within the Project Site and the proposed works will not cause direct or indirect impact to any known or unidentified items of historic significance. Potential low impact changes to visual amenity in the curtilage but not the residence associated with "Glenwood" were possible, however with the mitigation strategies no impact to historic heritage values are anticipated.

No works are proposed to impact on the well identified within the Development Corridor in Survey Area 19.

8.9 Water and Soils

Community consultation identified concerns regarding water and soils, including dust generation, erosion risks and adequate water supplies. The Project has responded to these concerns through a design evolution process that seeks to minimise the Development Footprint, while maintaining power generation capacity. In particular, this is reflected in the reduction in WTGs from 249 in 2013 to 97 as the proposal currently stands during the preparation of this EIS. The Project has been designed to minimise impacts to soils and water to ensure ongoing access among other resource users, both within the vicinity of the Project Site and downstream.

8.9.1 Introduction

This chapter summarises the potential impacts of the Project on surface water and groundwater resources, soils and land capability, geotechnical stability and geodiversity values of the Project Site. It documents the assessment methods and results, the initiatives built into the project design to avoid and minimise associated impacts to soil and land resources, and the mitigation and management measures proposed to address any residual impacts not able to be avoided. The Project SEARs relevant to soils (including current land use, and land capability), surface water and groundwater are:

- quantify water demand, identify water sources (surface and groundwater), including any licensing requirements, and determine whether an adequate and secure water supply is available for the development;
- access potential impacts on the quantity and quality of surface and groundwater resources, including impacts on other water users and watercourses;
- where the project involves works within 40 metres of the high bank of any river, lake (including wetlands) or estuary (collectively waterfront land), identify likely impacts to the waterfront land, and how the activities are to be designed and implemented in accordance with the DPI Guidelines for *Controlled Activities on Waterfront Land* (2018) and (if necessary) *Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings* (DPI, 2003); and
- describe the measures to minimise surface and groundwater impacts, including how works on steep gradient land or erodible soils types would be managed and any contingency requirements to address residual impacts.

This water resources and soil assessment has been developed in accordance with the requirements of the SEARs for the Project. The assessment included the following steps:

- Desktop assessment;

- Consideration of existing environmental conditions;
- Flood modelling (Appendix P);
- Impact assessment; and
- Identification of mitigation and management measures.

Potential impacts associated with the Project on agricultural land and mineral exploration activities within proximity to the Project Site have been considered as part of this assessment to ensure the compatibility of the development with existing land use on and adjacent to the Project Site during construction, operation and after decommissioning for the Project.

The discussion below is based on existing published data for the Project Site and surrounds and is complemented where possible by observations made during the biodiversity site inspections. Some desktop assessments undertaken are based on broad-scale mapping, hence it should be noted that the data confidence is very low due to estimation of landscape and soil properties, minimal soil profile data and no laboratory data.

Detailed mitigation and management measures are provided in Appendix P, and are summarised in Environmental Management (Section 9) as Statement of Commitments WS001, WS002, WS003, WS004, WS005 and WS006.

8.9.2 Existing Environment

8.9.2.1 Land Use

The Central West Orana regional economy has historically been based on agriculture, and it remains one of the most productive agricultural areas in Australia (DPE, 2017). The region features good access to water, high quality soils and suitable climates for a wide range of agricultural pursuits, including broad acre cropping, meat and wool production and forestry. While the total area of land available for agriculture in Australia is large, comparatively few locations have access to all these characteristics. Agricultural land occupies 306,900 ha or 90% of the Far West and Orana region (ABARES, 2020). The most common land use by area is grazing native vegetation which occupies 249,600km2 or 74% of the region (ABARES, 2020). In 2017, the gross value of agricultural production in the Central West Orana region was $1.3 billion, and the agriculture, forestry and fishing sector made up 11% of the region's employment (DPE, 2017).

All land within and surrounding the Project Site is zoned RU1 Primary Production. Under existing land management, the Project Site is used predominantly for sheep grazing, with some cattle grazing. To increase agricultural productivity, pastures in the Project Site have been improved, except for a few isolated areas of intact remnant vegetation. The land has been historically cleared and used for livestock grazing and some broadacre cropping. The Project Site was once dominated by open forest and woodland, which has now been extensively cleared for agricultural use. Whilst cropping operations are located within the landscape, due to the undulating topography and steep elevations in some sections, broad-acre cropping is not suitable across the majority of the Project Site. Surrounding land use includes extensive agriculture, residential dwellings associated with agricultural properties, State Conservation Areas (SCA) and Lake Burrendong to the south. There are three State Forests, two Nature Reserves, two National Parks and one Water Supply Reserve within a 30 km radius of the Project. An additional three unnamed reserves have been mapped by Geoscience Australia to the north of the Project.

8.9.2.2 Climate

The Project Site is located within the South Western Slopes bioregion. This bioregion is dominated by a sub-humid climate characterised by hot summers and no dry season (NPWS, 2003; OEH, 2016). Warm summers occur at higher elevation along the eastern boundary, however mean annual temperature (11 – 17°C) increases across the bioregion from low temperatures in the south to higher temperatures in the north and west (NPWS, 2003). Climate factors are a major influence on the character and potential hazards of any development site, including erosion and plant growth potential (DLWC, 2000).

The closest BoM weather station is at Wellington (Station 065034), located approximately 15 km west of the Project Site. The mean annual maximum temperature is 24.4°C and the mean annual minimum temperature is 9.4°C (BoM, 2020a). Mean annual rainfall is 613.2 mm and records indicate monthly mean rainfall received at the Site is highest in the months of November – January, however summer rainfall is not strongly dominant compared to winter rainfall (BoM, 2020a). The mean number of rainfall days >1 mm is higher in winter and range between 3.8 days (April) to 6.2 days (June) (BoM, 2020a). However, mean rainfall days >25 mm are less frequent, ranging from 0.2 days in August to 0.7 days in January, and are generally higher in the winter months (0.5 days) (BoM, 2020a). This indicates that while mean rainfall at the Project Site is summer dominant, rainfall intensity is generally distributed evenly throughout the year.

Over the past 40 years, the rainfall record (Figure 8-30) indicates relatively consistent conditions, as shown by the largely horizontal trends in the cumulative rainfall departure (CRD). Within this time period, however, there have been relatively drier periods, shown as declining trends in the CRD (Figure 8-30). Recent dry periods occurred from 1979 to 1988, 2000 to 2008 and 2016 to 2020.

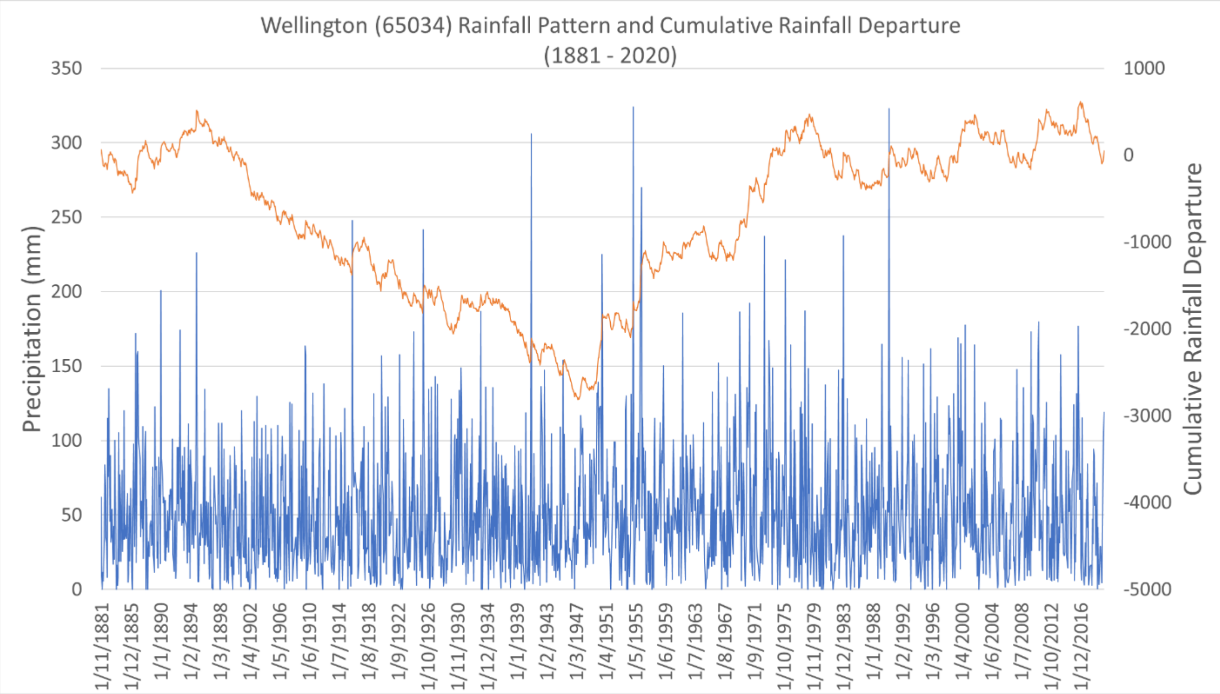


Figure 8-30: Monthly rainfall and the cumulative rainfall departure (CRD) at Wellington (65034) since 1881 (BoM, 2020a)

In Wellington, wind speeds are generally higher in the afternoon (3 pm conditions) and are generally stronger and more frequent in spring and summer, and predominantly south westerlies (BoM, 2020a).

8.9.2.3 Topography

The Project Site is located upon an elevated ridge line associated with the Mount Arthur Reserve, situated to the west of Wellington. The topography of the Project Site is generally gently undulating to undulating with numerous valleys and peaks. Elevations within the Site vary from 359 to 705 m AHD (Australian Height Datum); averaging 543 m AHD. The topography of the region area is shown in Figure 8-31 and the slopes are shown in Figure 8-32. Burrendong SCA surrounds Lake Burrendong with elevated ridges to the south of the Project Site. The character of the landscape has shifted considerably over time due to European settlement. Gentle slopes have been cleared to increase grazing areas however, areas with steeper, rugged ridges and rangers or areas close to creek lines, along roadsides and property boundaries remain vegetated.

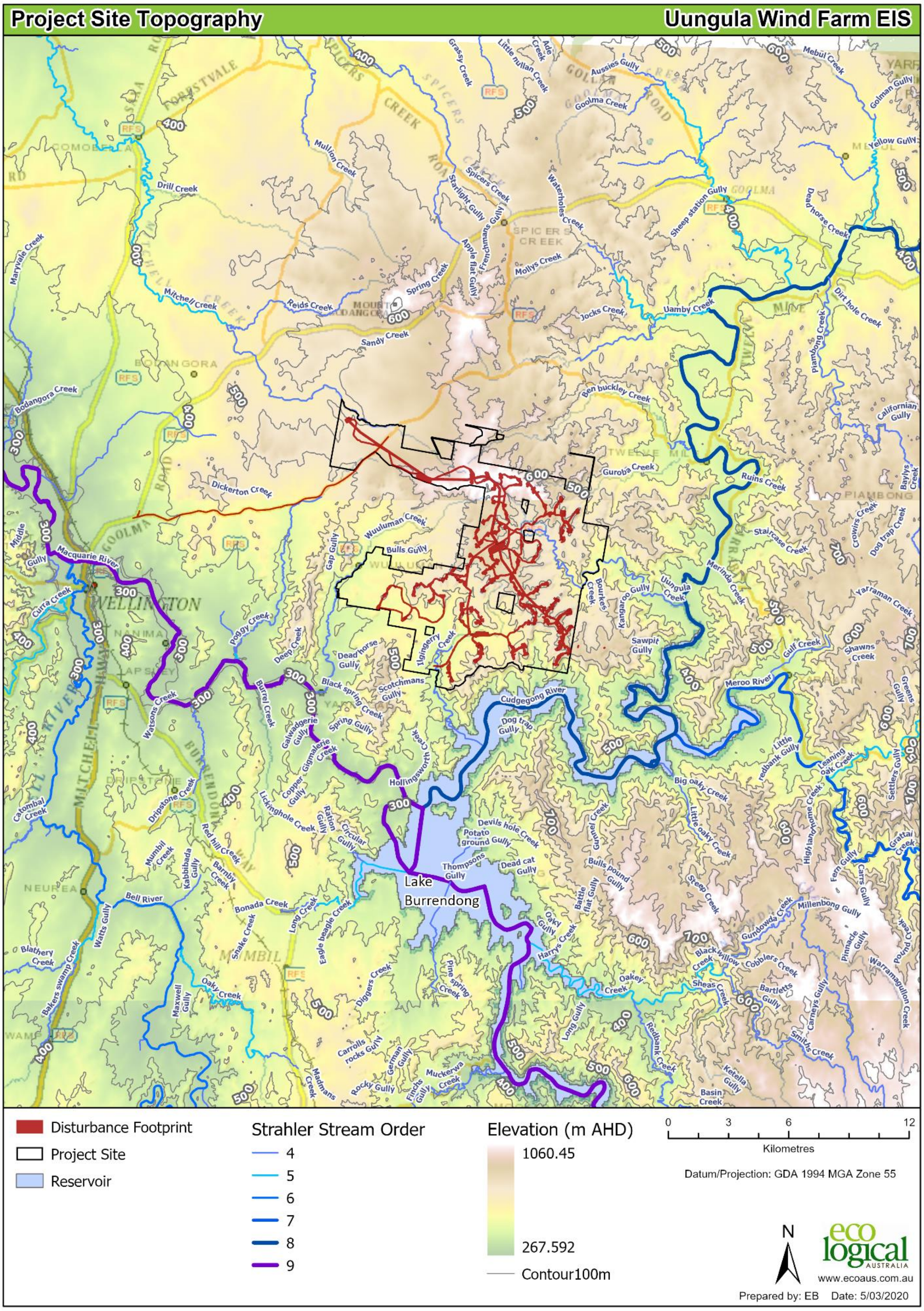


Figure 8-31: Regional topography around the proposed Project Site

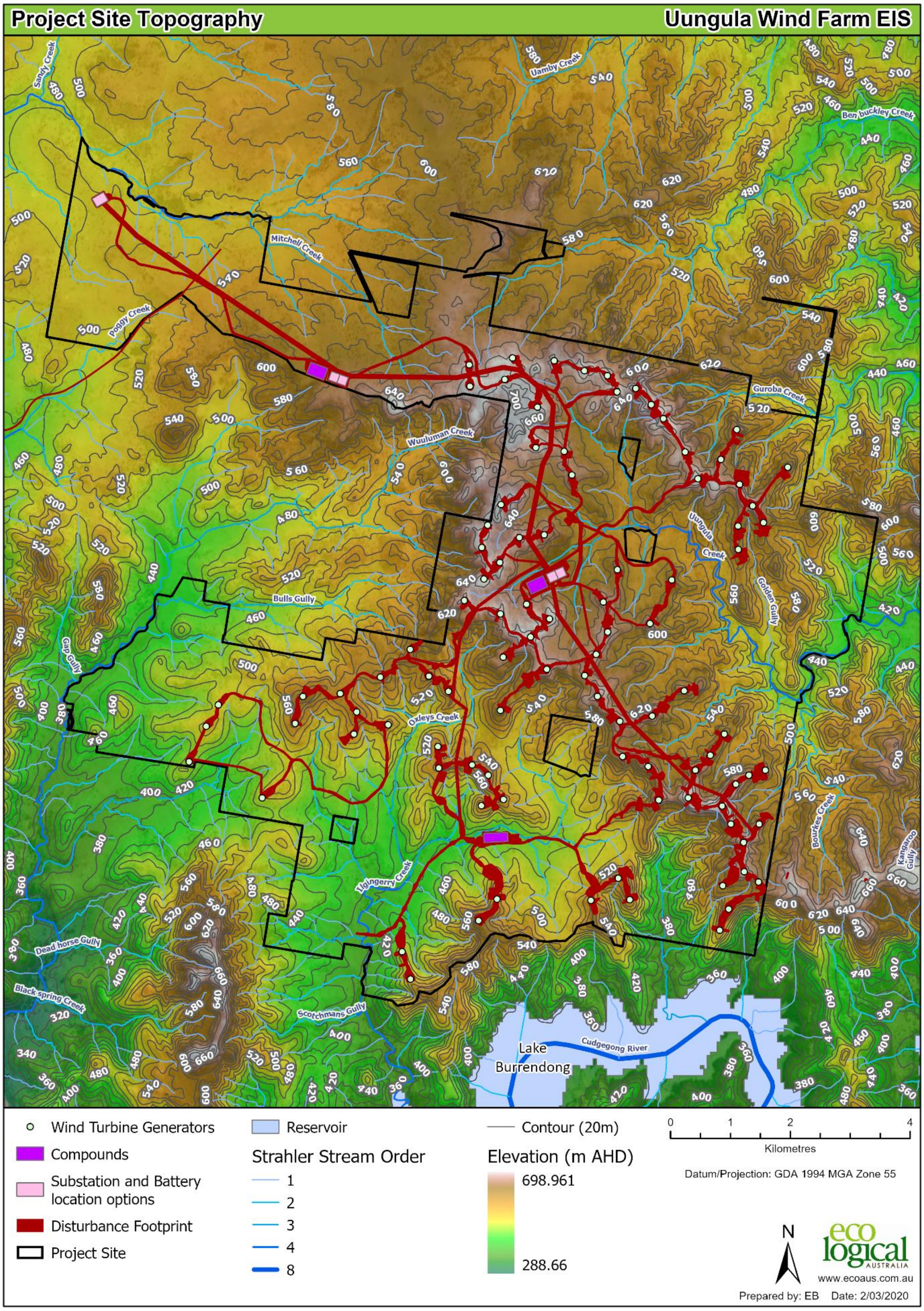


Figure 8-32: Relative topography of the Project Site – contour map showing slopes

8.9.2.4 Regional Catchment

The Project Site is within the Macquarie River catchment area which spans over 74,000 km^2, originating near Bathurst in Central Western NSW and travelling generally north-west through the towns of Wellington, Dubbo Narromine and Warren (NSW DPIE-Water, 2020).

The Cudgegong River, a main tributary of the Macquarie River, runs east of the Project Site with several smaller tributaries running through the landscape comprising 1st, 2nd, 3rd and 4th order Strahler streams and ephemeral creeks (Strahler, 1952), including Uungula Creek, Bourkes Creek, Mitchell Creek, Ben Buckley Creek, Oxleys Creek, Bulls Gully and Ilgingery Creek. Flows from the Cudgegong River confluence with the Macquarie River at Burrendong Dam, approximately 7 km to the of the Project Site. The Macquarie River drains to the Macquarie Marshes and the Barwon-Darling River, which joins the Murray River in southern NSW before flowing into the Southern Ocean.

The Project Site is located mostly within the Goolma Creek water source and partially within Maryvale Geurie Creek water source, in the area where surface water is managed by the Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Water Sources 2012 which commenced on 4 October 2012. The Burrendong Dam is managed by the Water Sharing Plan for the Macquarie and Cudgegong Regulated Rivers Water Source 2016, which provides for the planned environmental water and stock & domestic flows. The NSW Government also manages licensed water for the environment.

Two major water storages, (Windamere Dam on the Cudgegong River and Burrendong Dam on the Macquarie River), regulate water within the Macquarie River Catchment (NSW DPIE-Water, 2020). Lake Burrendong, which was created with the construction of Burrendong Dam, is one of the largest inland dams in NSW and the most prominent water body of the region with a total capacity of 1,678,000 ML, including 489,000 ML of air space potential for flood mitigation (Figure 8-33). Commonwealth environmental water delivery is gravity fed from Burrendong Dam into the Macquarie River to downstream environmental assets such as the Macquarie Marshes and distributary creeks. Regulating structures, such as the dam at Lake Burrendong, are utilised to manage the diversion of water into distributary creeks at lower rates. At higher flow rates, water may flow overbank or via flood runners onto floodplains and wetlands.

Figure 8-33: Lake Burrendong looking north east towards the Project Site

8.9.2.5 Surface Water and Hydrology

The Project Site comprises 16 sub-catchment areas (Figure 8-34) that drain via 1st, 2nd, 3rd and 4th order streams (Strahler, 1952; Figure 8-35) into the Macquarie River, Cudgegong River and Lake Burrendong.

On the western and north-western side of the Project Site, surface water drains to Wuuluman Creek and Mitchell Creek, which are small tributaries of the Macquarie River. On the eastern and north-eastern side of the Project Site, surface water drains to Uungula Creek, Geroba Creek and Ben Buckely Creek, which are small tributaries of the Cudgegong River. On the southern side of the Project Site, surface water drains to Ilgingery Creek that feeds into Lake Burrendong. Lake Burrendong is to the south of the Project Site, the Cudgegong River is to the east and the Macquarie River is to the west, which act as receiving water bodies for surface and groundwater flows. The Burrendong Dam Reservoir is the only waterbody identified in the Wetland GIS of the Murray-Darling Basin Series 2.0 (Murray Darling Bain Authority, 2018) located within 10 km of the Project Site.

Most waterways within the Project Site, including Ilgingery Creek and Uungula Creek, are defined as ephemeral and only have surface flows after heavy rainfall events within the catchment area. These ephemeral creeks and gullies were predominantly dry during the assessment period, generally lack aquatic vegetation and are dominated by grasses. Due to historic agricultural practices and absence of riparian vegetation, many of the watercourses within the Site are incised and channel banks show evidence of exacerbated erosion. In some areas, extensive erosion has deepened the channel and left large parts of the bed and bank as bare soil. Pools persist in some higher order streams, and these pools become larger and more permanent downstream of the Project Site boundary, closer to the Cudgegong River. Permanent water sources within the Project boundary are dominated by holes along these ephemeral creeks and gullies, or farm dams. Numerous farm dams are located along these watercourses, as well as scattered elsewhere across the Project Site. These act as refuge habitat for aquatic fauna during periods of no rainfall.

The nearest operational downstream flow gauging station is along the Macquarie River at Downstream Burrendong Dam (421040), located approximately 7 km south of the Project Site, draining a catchment area of 2,240 km^2. Operational since 1949, the average monthly flow at 421040 is 74,645 ML, with the highest average monthly discharge occurring during December (104,306 ML) and the lowest in May (24,633 ML). The nearest upstream gauge is along the Cudgegong River at Yamble Bridge (421059), located approximately 16 km from the Project Site. The average monthly flow is 12,085 ML, with the highest average monthly discharge occurring during July (12,085 ML) and the lowest in May (6,217 ML).

Water access within the Project Site is in accordance with the Water Sharing Plan for the Macquarie Bogan Unregulated and Alluvial Water Sources 2012. River Flow Objectives for Uncontrolled Streams within the Macquarie-Bogan River (DECCW, 2006b) include:

- Protect pools in dry times, natural low flows, and important rises in water levels;
- Mimic natural drying in temporary waterways;
- Maintain wetland and floodplain inundation;
- Manage groundwater for ecosystems;
- Make water available for unforeseen events; and,
- Minimise the effect of weirs and other structures.

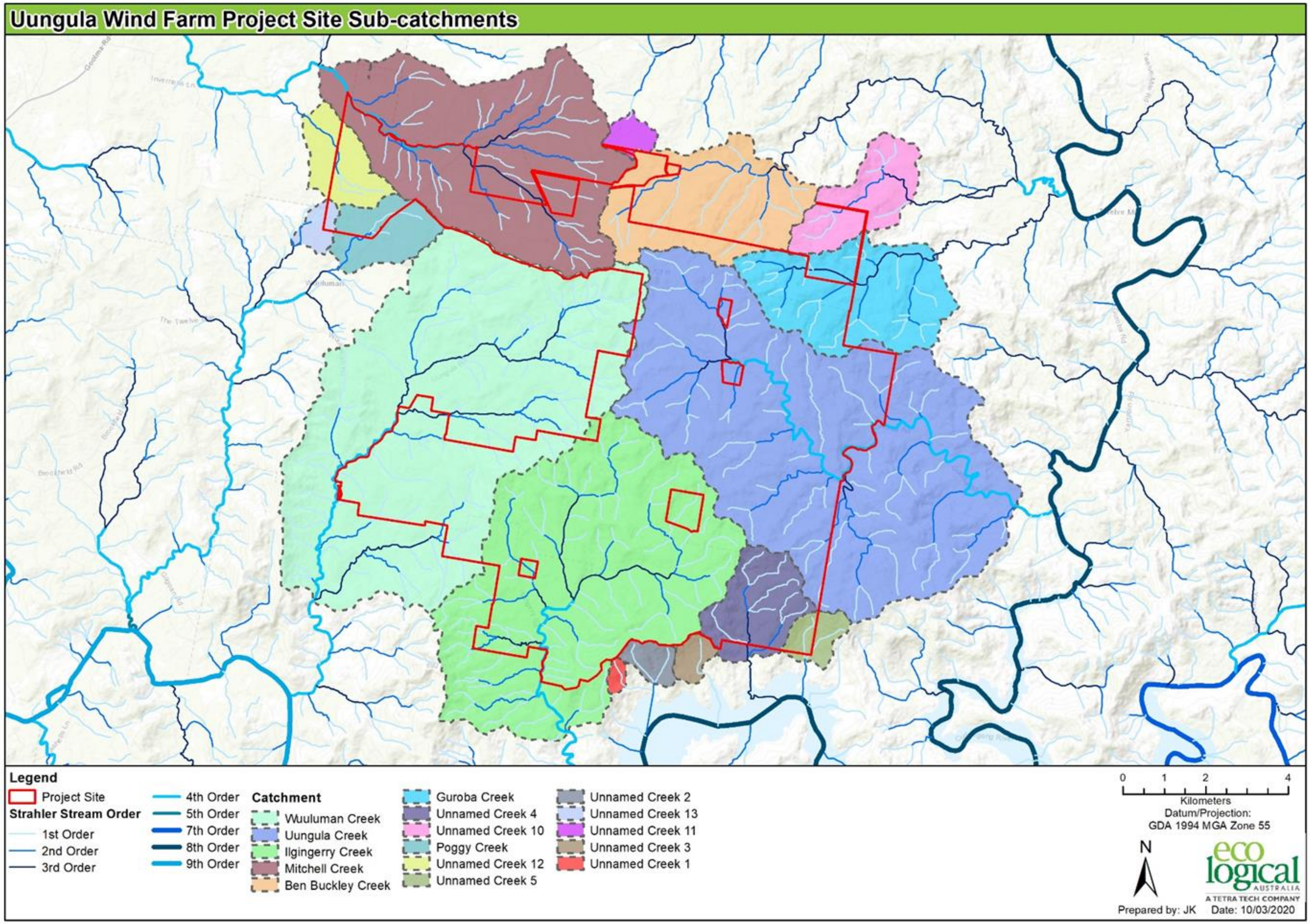


Figure 8-34: Location of the Project Site relative to the drainage sub-catchments

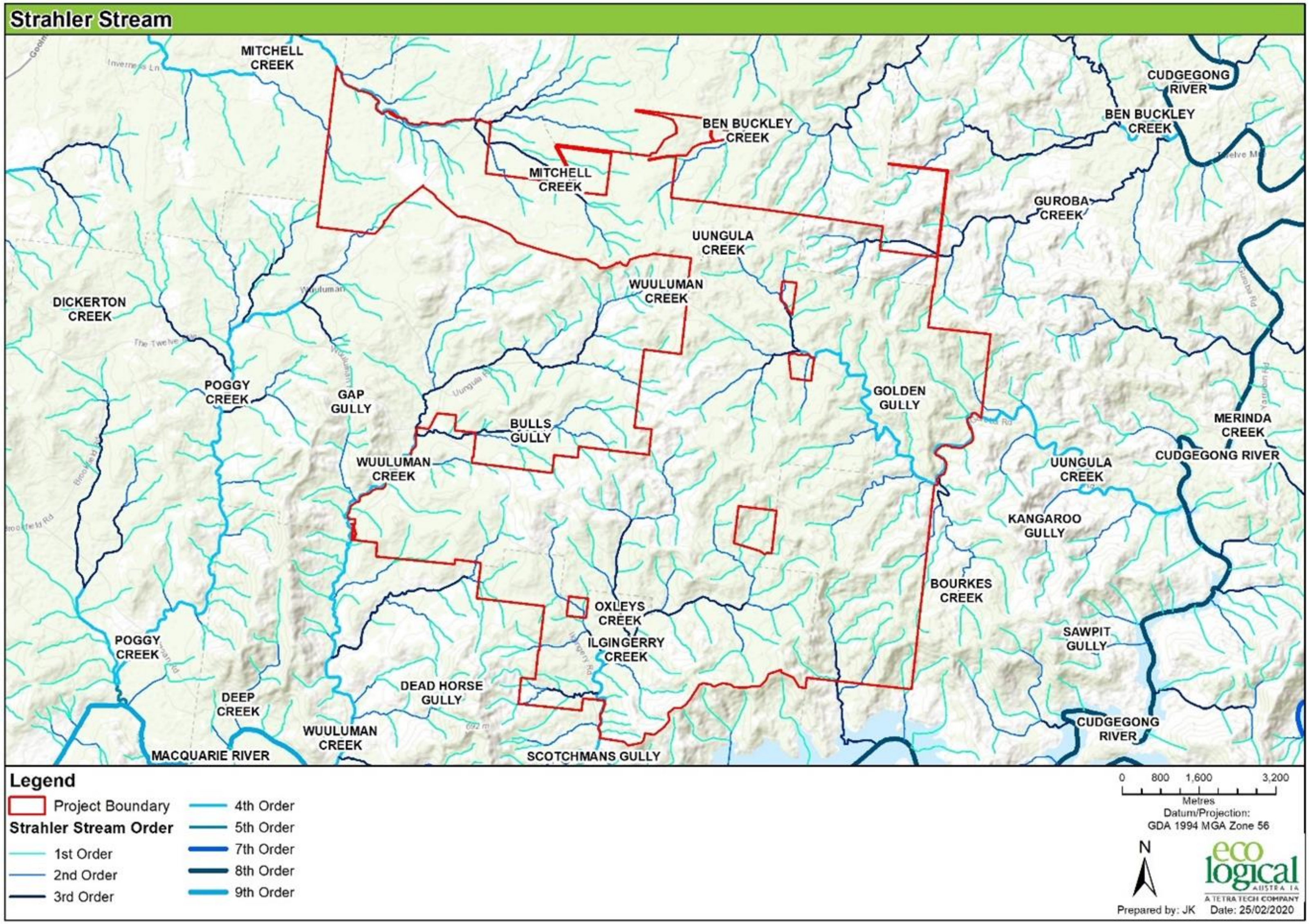


Figure 8-35: Surface water resources - Mapped watercourses drainage lines, wetlands, farm dams and Strahler Stream Order within the Project Site

Riparian Land

Most riparian corridors throughout the Project Site are substantially degraded, having been cleared, grazed, and modified to support agricultural activities. The Natural Resources Access Regulator (NRAR) provides guidelines for Vegetated Riparian Zone (VRZ) width based on the watercourse order as classified under the Strahler system for ordering watercourses (NRAR, 2018). Where watercourses within the Project Site meet the definition of a 'river' under the WM Act, VRZs shall be considered as per the recommended riparian corridor widths outlined in Table 8-39 below (illustrated in Figure 8-36, Figure 8-37, Figure 8-38 and Figure 8-39).

As the Project is classified as SSD, a water management work approval under section 90, or an activity approval under section 91 of the WM Act is not required where the development consent for the SSD authorises the carrying out of those works. Accordingly, the controlled activities undertaken within VRZs (e.g. road crossings and installation of cables) will be undertaken with reference to relevant NSW Government guidelines.

Where a watercourse does not exhibit the features of a defined channel with bed and banks, the NRAR may determine that the watercourse is not waterfront land for the purposes of the WM Act. In such cases, VRZs shall be established in accordance with NRAR riparian corridor guidelines, adopting the rationale provided below (Table 8-39).

Table 8-39: Recommended riparian corridor widths (adapted from NSW NRAR, 2018)

Stream order	Watercourse type[1]	NRAR Guideline VRZ width (each side of watercourse)	Guideline total riparian corridor width	Adopted VRZ width (each side of watercourse)[2]	Justification
1st	Any permanent flowing 1st order watercourse.	10 m	20 m plus channel width	0 m – 10 m	Some 1st order streams in the Project Site do not have defined channels, beds or banks and in those cases a VRZ of 0m will be adopted.
2nd	Any 2nd order watercourse where there is a defined channel where water flows intermittently or permanently.	20 m	40 m plus channel width	0 m – 20 m	Some 2nd order streams in the Project Site do not have defined channels, beds or banks and in those cases a VRZ of 0m will be adopted.
3rd	Any 3rd order watercourse where there is a defined channel where water flows intermittently or permanently.	30 m	60 m plus channel width	20 m	Most riparian zones in the Project Site are highly disturbed and degraded. In addition, the beds and banks of some of these channels are poorly defined. Therefore, a 20 m VRZ width has been adopted either side of the thalweg.
4th and greater	Any 4th order or greater watercourse and where there is a defined channel where water flows intermittently or permanently. Includes estuaries, wetlands and any parts of rivers influenced by tidal waters.	40 m	80 m plus channel width	20 m	Most riparian zones in the Project Site are highly disturbed and degraded. In addition, the beds and banks of some of these channels are poorly defined. Therefore, a 20m VRZ will be adopted.

[1] as classified under the Strahler System of ordering watercourses and based on current 1:25,000 topographic maps.

[2] merit assessment based on riparian functionality of the river, lake or estuary, the site and long-term land use.

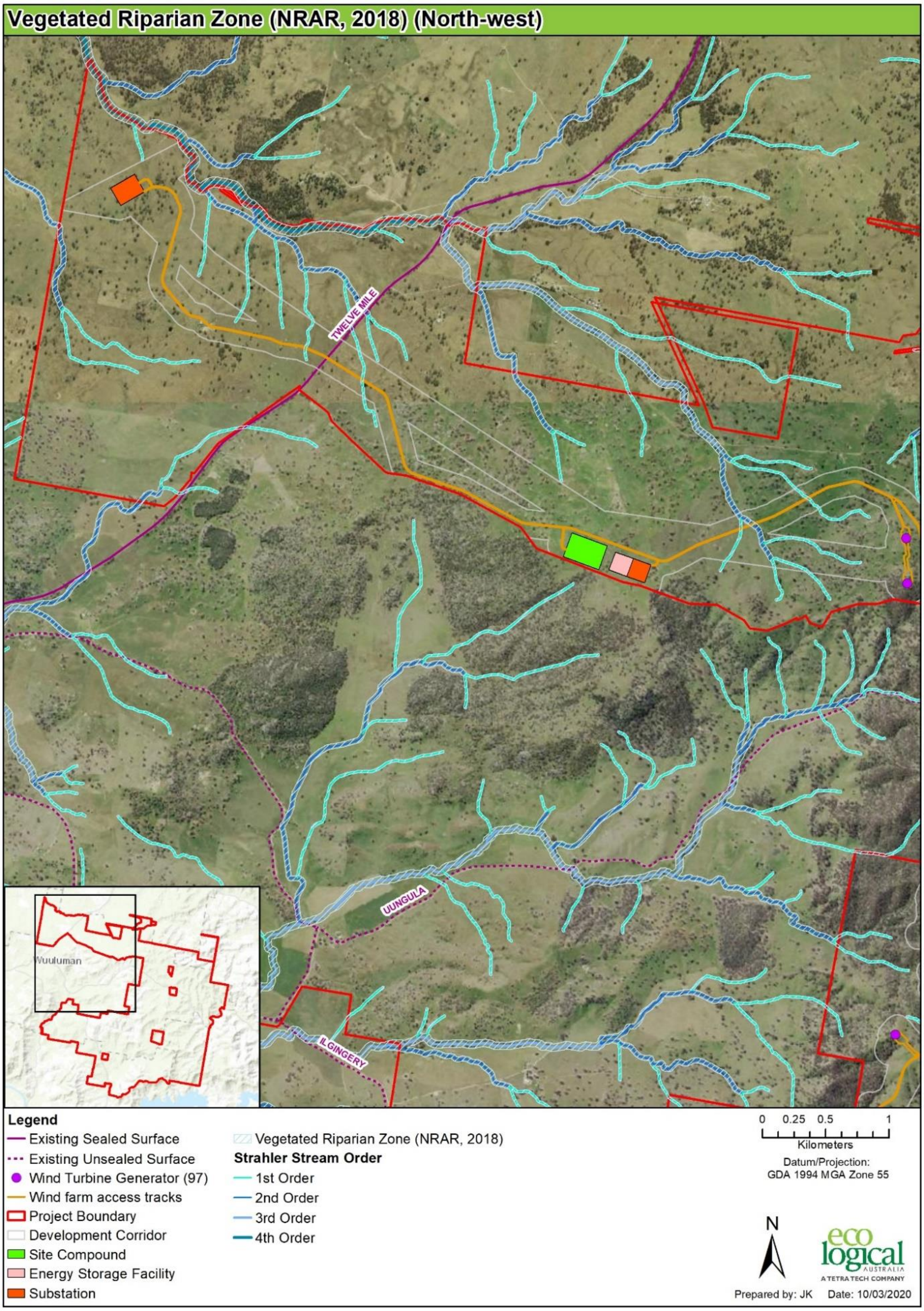


Figure 8-36: Guideline VRZ widths, north-west

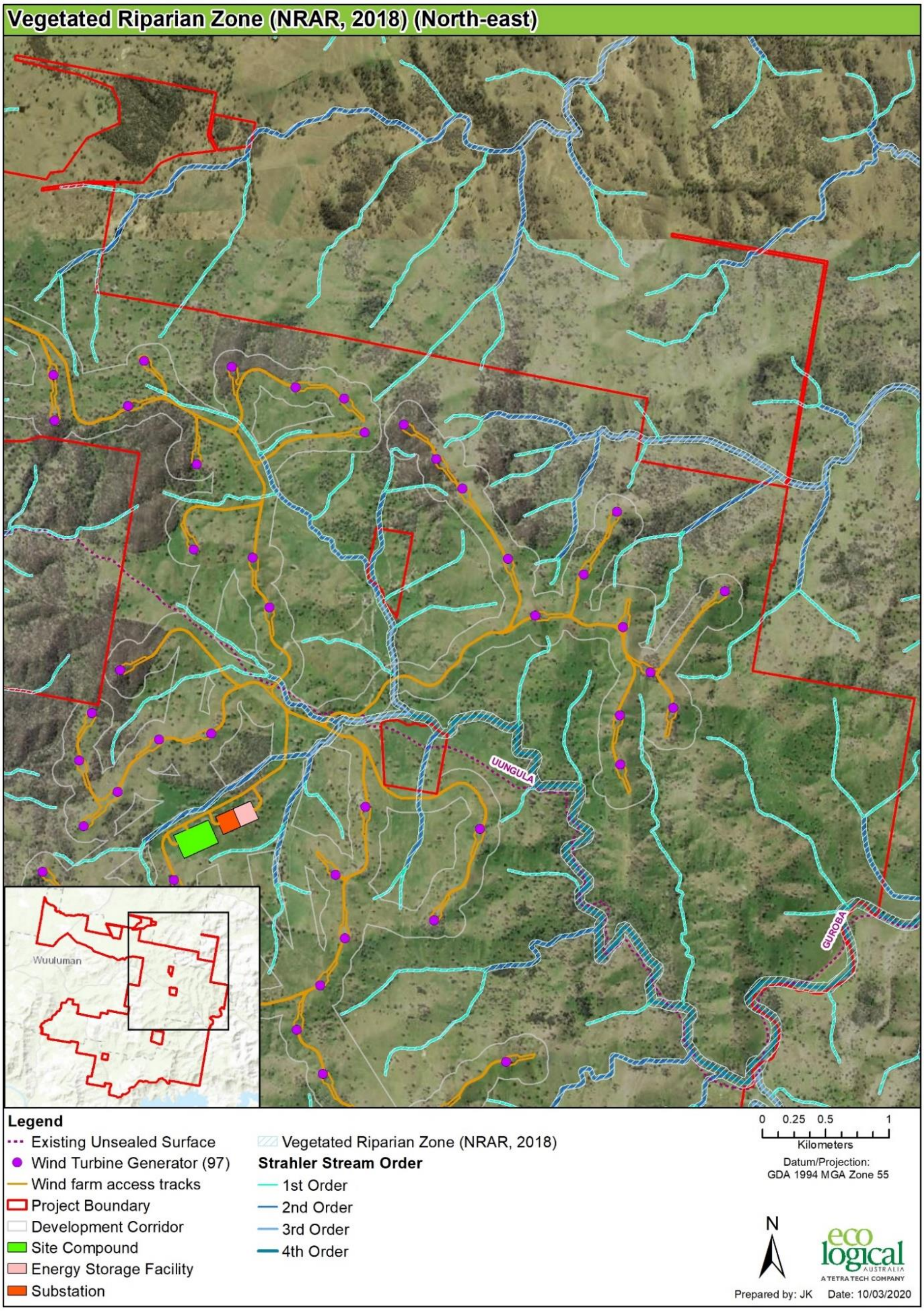


Figure 8-37: Guideline VRZ widths, north-east

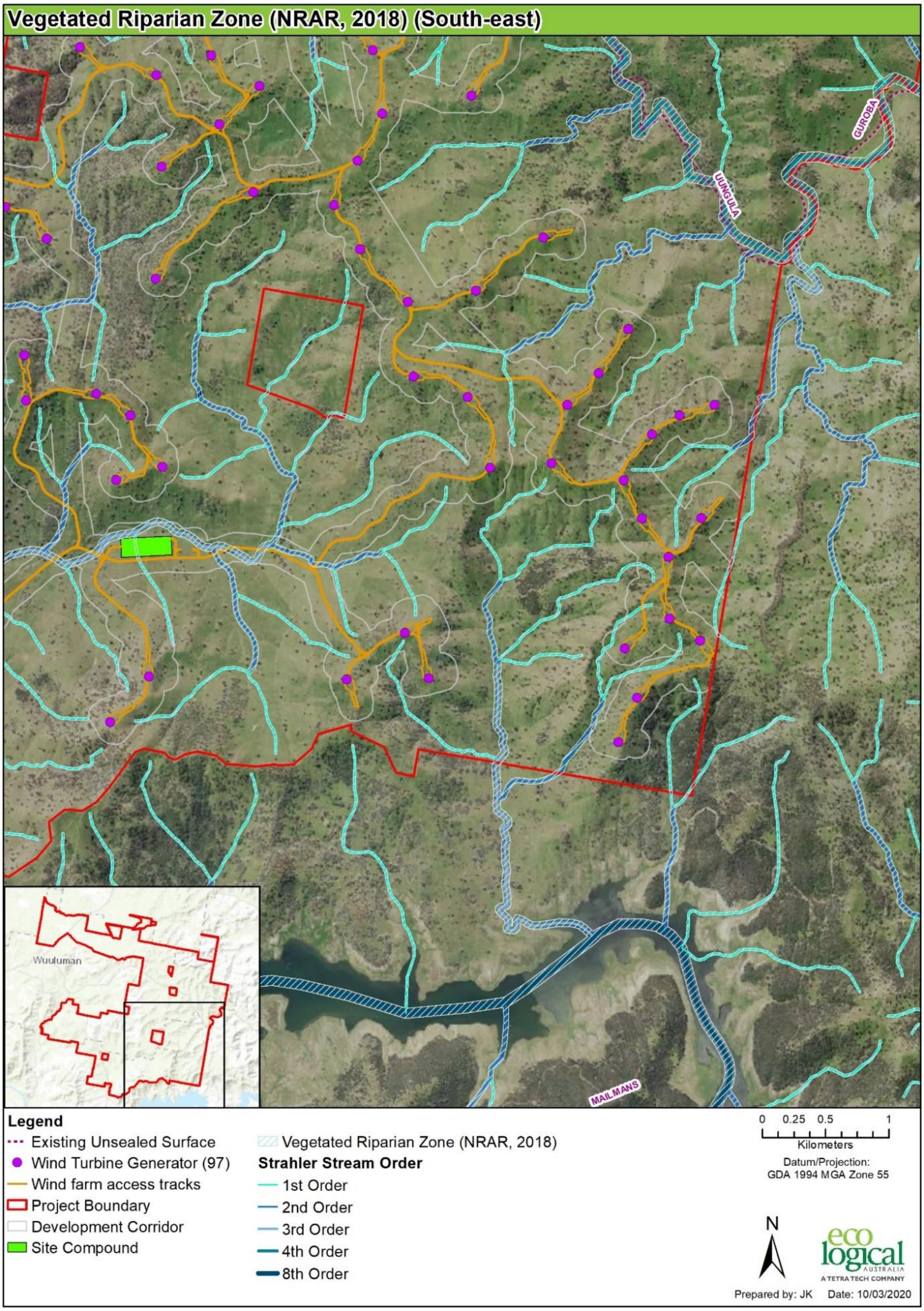


Figure 8-38: Guideline VRZ widths, south-east

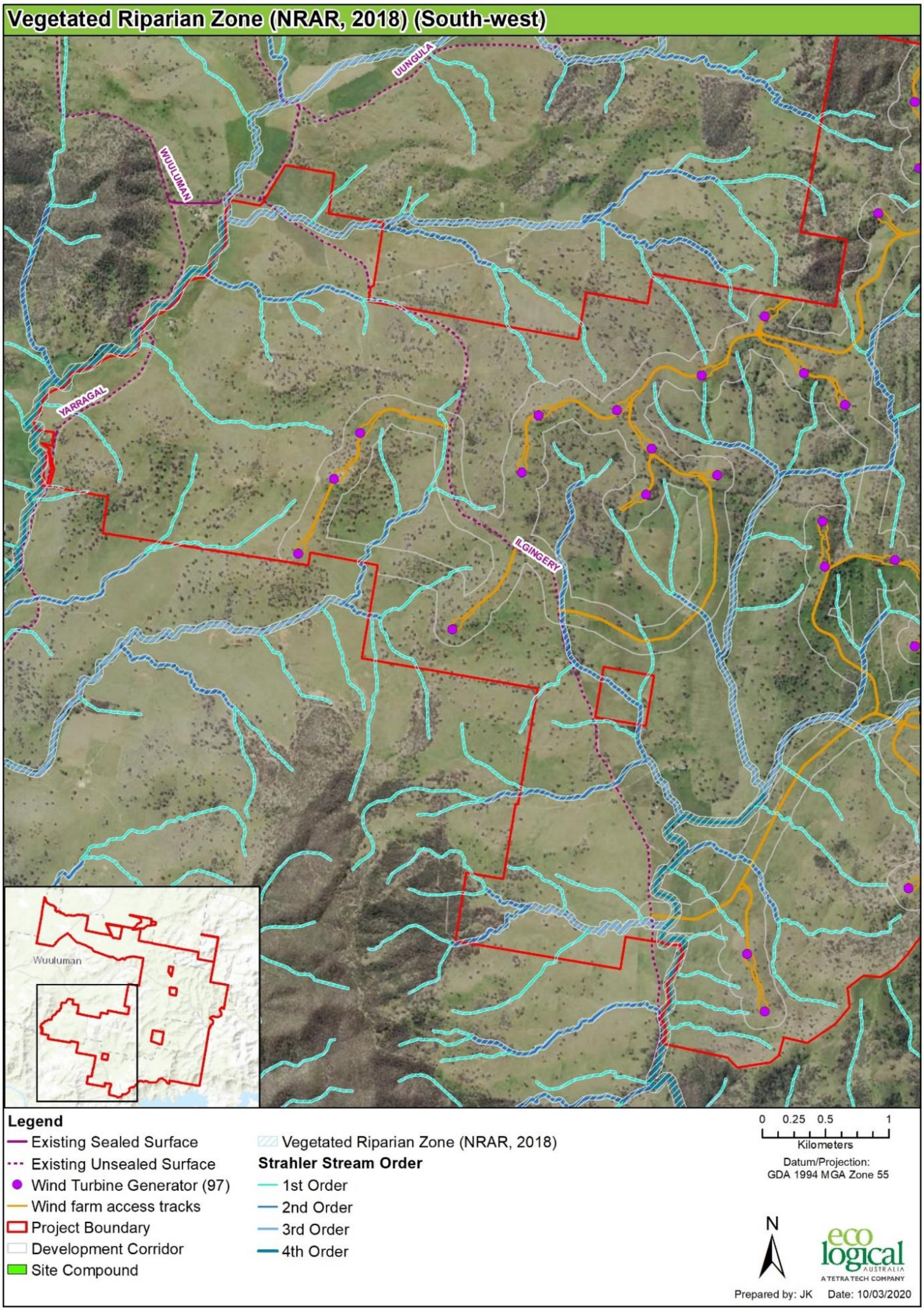


Figure 8-39: Guideline VRZ widths, south-west

8.9.2.6 Water Quality

Water Quality Objectives for Uncontrolled Streams within the Macquarie-Bogan River (DECCW, 2006a) include:

- Maintaining or improving the ecological condition of waterbodies and their riparian zones over the long term;
- Aesthetic qualities of waters;
- Maintaining or improving water quality for activities such as boating and wading, where there is a low probability of water being swallowed;
- Maintaining or improving water quality for activities such as swimming in which there is a high probability of water being swallowed;
- Protecting water quality to maximise the production of healthy livestock;
- Protecting the quality of waters applied to crops and pasture;
- Protecting water quality for domestic use in homesteads, including drinking, cooking and bathing;
- Protecting the quality of drinking water drawn from the raw surface and groundwater sources before any treatment: and
- Protecting water quality so that it is suitable for the production of aquatic foods for human consumption and aquaculture activities.

The current investigations were unable to identify any routine water quality monitoring that has been undertaken within or surrounding the Project Site. Therefore, an assessment of regional water quality was undertaken as part of the assessment of the Basin Plan water quality targets by the NSW DPI Water for the period 2007 – 2012 (Mawhinney & Muschal, 2015). This showed mixed results for several sites located within the Castlereagh, Lachlan, Macquarie and Murrumbidgee (upland) water quality zones, while the overall catchment rating was ‘good’. The closest monitoring site, located on the Macquarie River upstream of the spillway at Burrendong Dam, achieved an overall rating of poor for water quality, very poor for Total Phosphorus and Total Nitrogen, poor for Dissolved Oxygen, moderate for turbidity measured in the laboratory and good for turbidity measured in the field and pH. This assessment was undertaken based on water quality targets set by the Basin Plan, however, when compared to the ANZECC guidelines, all water quality variables were below the relevant guideline.

8.9.2.7 Flooding

Primary overland flow paths and catchment watersheds relevant to the Project were delineated using the ArcHydro Tool within the ArcGIS ESRI software. Flood modelling was then undertaken to assess the impacts of the Project using rain-on-grid water level modelling in HEC-RAS (Hydrologic Engineering Center's River Analysis System) software (U.S. Army Corps of Engineers, 2008). The modelling assessed the likely effects of the Project on flooding, and the potential impacts of any changes on the downstream environment. Further details of the model configuration are presented in Appendix P.

Inundation extent maps for existing conditions were generated for 10%, 1%, 0.5%, 0.2% and 0.1% Annual Exceedance Probability (AEP) design events (1 in 10-year, 100-year, 200-year, 500-year and 1000-year Average Recurrence Interval (ARI) respectively) and can be viewed in Appendix P. The existing conditions flood depths showed that, in general, the flows are concentrated to the waterways in the region with enough terrain relief to limit the amount of sheet flow. An example of this is shown in Figure 8-40.

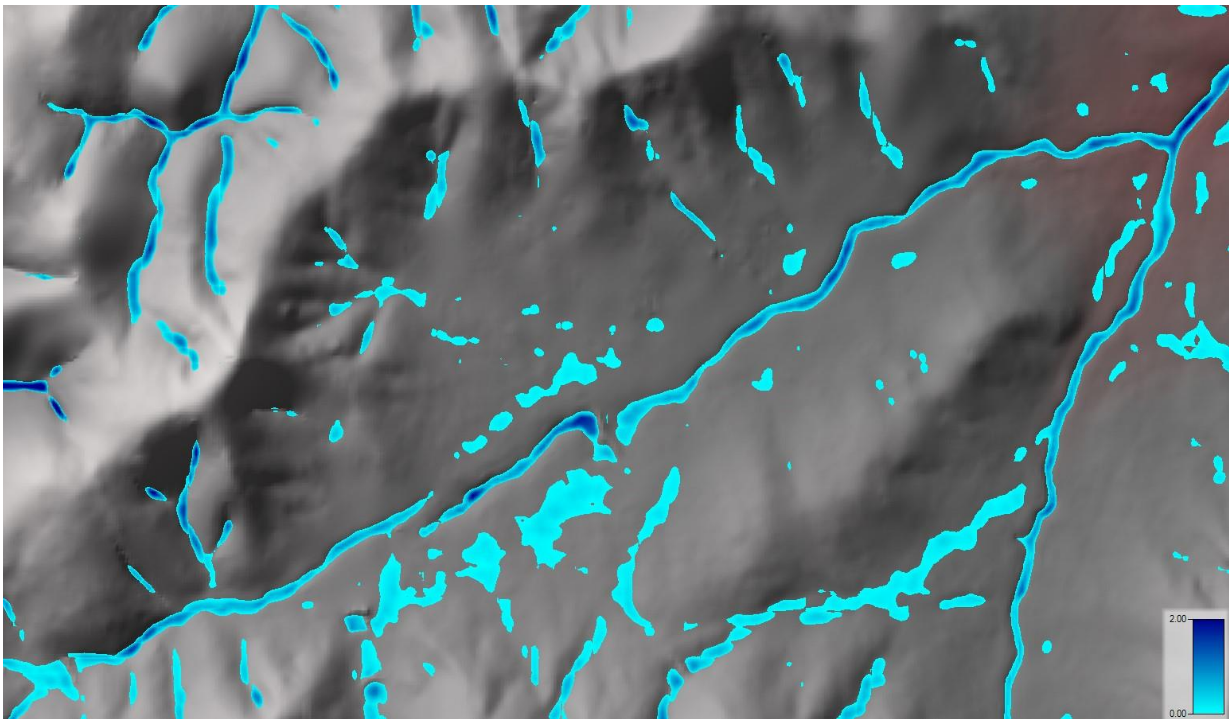


Figure 8-40: Existing conditions 10% AEP flood depths for a region within the Project Site. Depth scale between 0 metres and 2 metres

Under existing conditions, velocities showed that in general, the flows are of low velocity in the lower order (Strahler) waterways. Once the water reaches higher order streams, more major waterways, the velocities increase towards and over critical velocities for which stream protection may be required (generally >2 m/s). This would depend on the local geomorphology. An example of isolated locations where this may occur is shown in Figure 8-41.

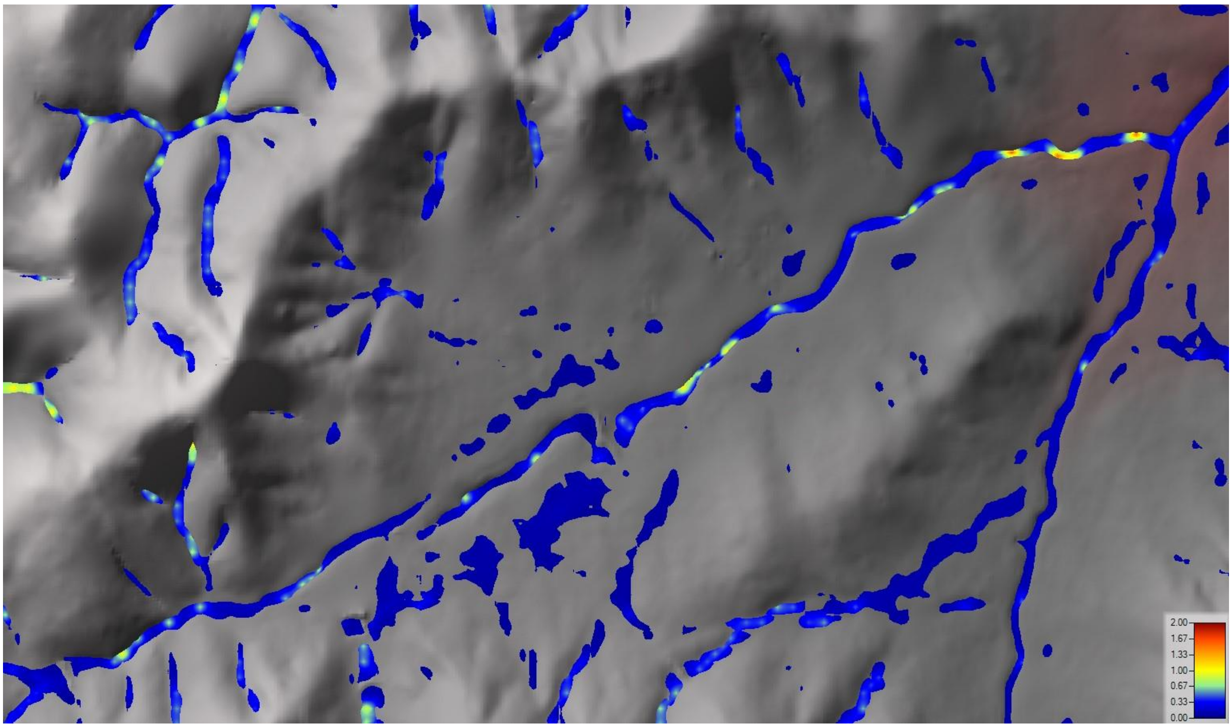


Figure 8-41: Existing conditions 10% AEP velocities for a region of the Project Site. Velocity scale between 0 m/s and 2 m/s

8.9.2.8 Mitchell Landscapes

Mitchell Landscapes are defined ecosystem units based upon geologic, geomorphic and pedologic factors (Mitchell, 2002). Four Mitchell Landscapes intersect the Project Site (Figure 8-42; Mitchell, 2002):

- Ophir - Hargraves Plateau (7,954 ha, all 97 WTGs proposed within this);
- Bodangora Granites (1,306 ha);
- Macquarie Turon Gorges (48.3 ha, no development proposed); and
- Macquarie Alluvial Plains (47.7 ha, no development proposed).

The Ophir - Hargraves Plateau landscape consists of subdued strike ridges and dissected plateau on tightly folded Silurian and Devonian dacite, tuffaceous greywacke, crystal tuff, lithic sandstone and slate and has a general elevation of 500 to 1,000 m AHD with local relief 100 to 150 m (Mitchell, 2002). Soils are described as abundant rock outcrop with thin sandy loam grading to thin stony red texture-contrast soil on slopes and yellow harsh texture-contrast soil with bleached A2 horizons in valleys. The Ophir - Hargraves Plateau landscape has been extensively cleared and cropped, and the vegetation was formerly woodland to open forest of Eucalyptus dives (Broad-Leaved Peppermint), *E. macrorhyncha* (Red Stringybark), *E. rossii* (Inland Scribbly Gum), *E. rubida* (Candlebark) and *E.*

melliodora (Yellow Box) in lower positions. More northerly areas include *E. polyanthemos* (Red Box), *E. cypellocarpa* (Mountain Grey Gum) and *E. bridgesiana* (Apple Box) (Mitchell, 2002).

The Bodangora Granites landscape consists of an Isolated rounded mountain peak with common rock outcrop and tors on Carboniferous granite and granodiorite and has a general elevation of 500 to 740 m AHD with local relief 180 m (Mitchell, 2002). Soils are described as gritty gradational red earth on the crest and red texture-contrast soil on the slopes. The Ophir - Hargraves Plateau landscape has been extensively cleared and cropped, and the vegetation was formerly forest of *Eucalyptus melliodora*, *E. blakelyi* (Blakely's Red Gum), *E. macrorhyncha*, *E. bridgesiana*, *E. dalrympleana* (Mountain Gum) and *Callitris endlicheri* (Black Cypress Pine) (Mitchell, 2002).

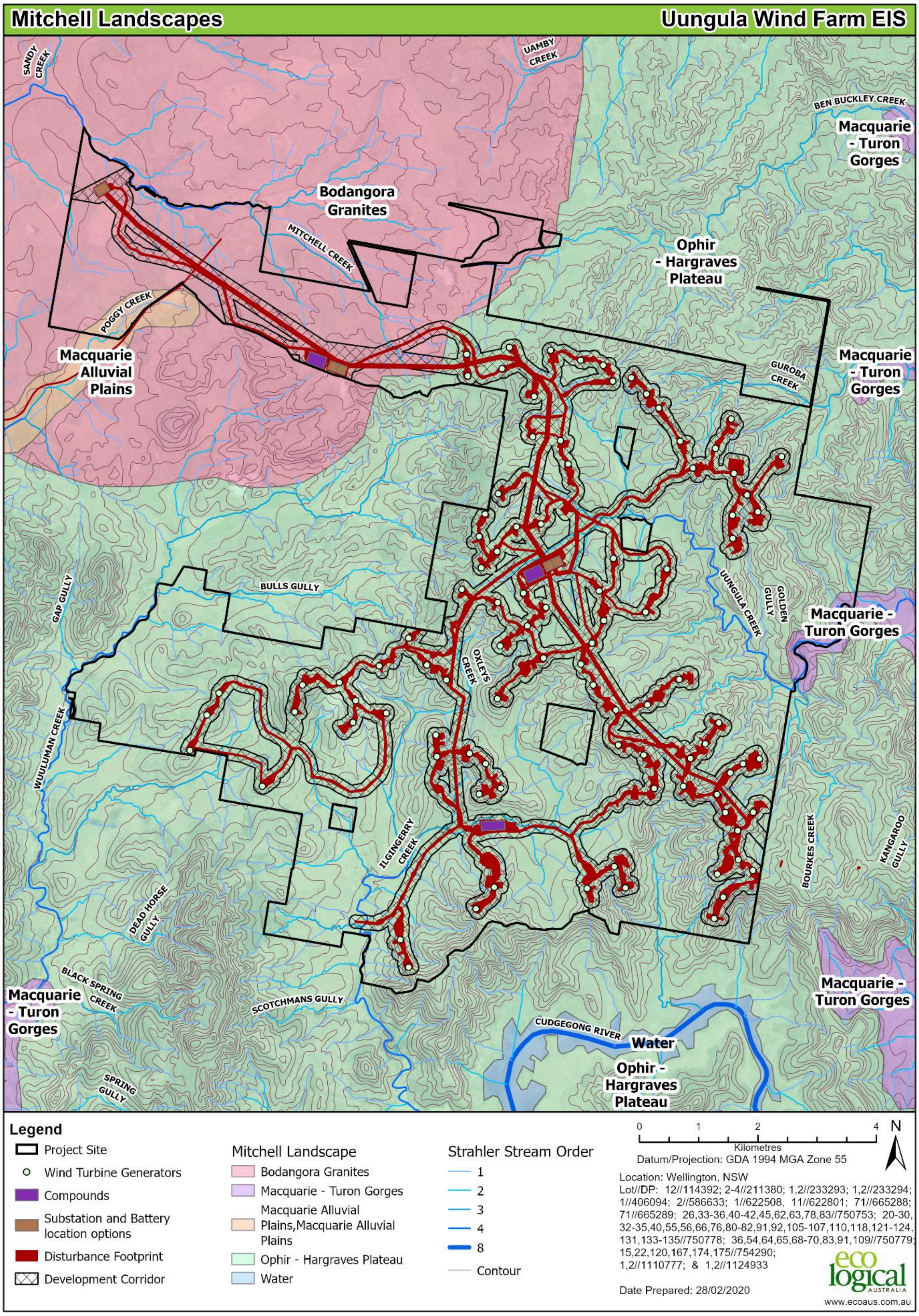


Figure 8-42: Mitchell Landscapes

8.9.2.9 Geology

The geology of the soils at the Project Site consists of a wide range of rock types from sediments, metamorphosed sediments and intrusive and extrusive volcanics. The Project Site is located within the western portion of the Lachlan Fold Belt (LFB) region of NSW (Morgan, Scott & Cameron, 2000; Geoscience Australia, 2020). The geology is structurally deformed with numerous folds and minor fault lines. The dominant surface geology at the Project Site is Devonian aged units of slate, siltstone, shale with lesser lithic sandstone. There are Carboniferous volcanic intrusions in the north west of the Project Site, with small areas of alluvial silt, clay and sand with some alluvial regolith deposits. In the south west there are older (Silurian aged) shales, siltstones and calcareous sandstones. The geology is shown in Figure 8-43 and a description of the mapped geological units is presented in Table 8-40.

The LFB is prominent due to the high rate of economic mineral occurrences that exist throughout it. Within the Project Site previous works have identified one gold deposit, with one other gold deposit within 200 m of the Project Site and one metalliferous deposit (containing gold, silver, copper, lead and molybdenum) is located within 500 m of the Project Site. These deposits occur within volcanic sedimentary sequences which have been subsequently metamorphosed, typical of deposit types throughout the fold belt. Given that the Project Site is located within this lithology type and the proximity of mineral deposits nearby, there is the potential for undiscovered mineral deposits to exist within the Project Site.

The “Natural Resource - Karst Map - Sheet NRK_004” map within the Wellington LEP identifies areas of subsidence risk from karst topography within part of the Project Site and surrounds that are mapped as Cuga Burga Volcanics / Gregra Group (Dgc on the geology map Figure 8-43). Karst regions may provide conditions suitable for aquifer-dependent (Type 1) GDEs. Under Part 6 Clause 6.6 of the Wellington LEP, a development’s design and construction methods on land identified as “Karst” needs to be managed so as to not disturb the underlying geotechnical conditions of the land.

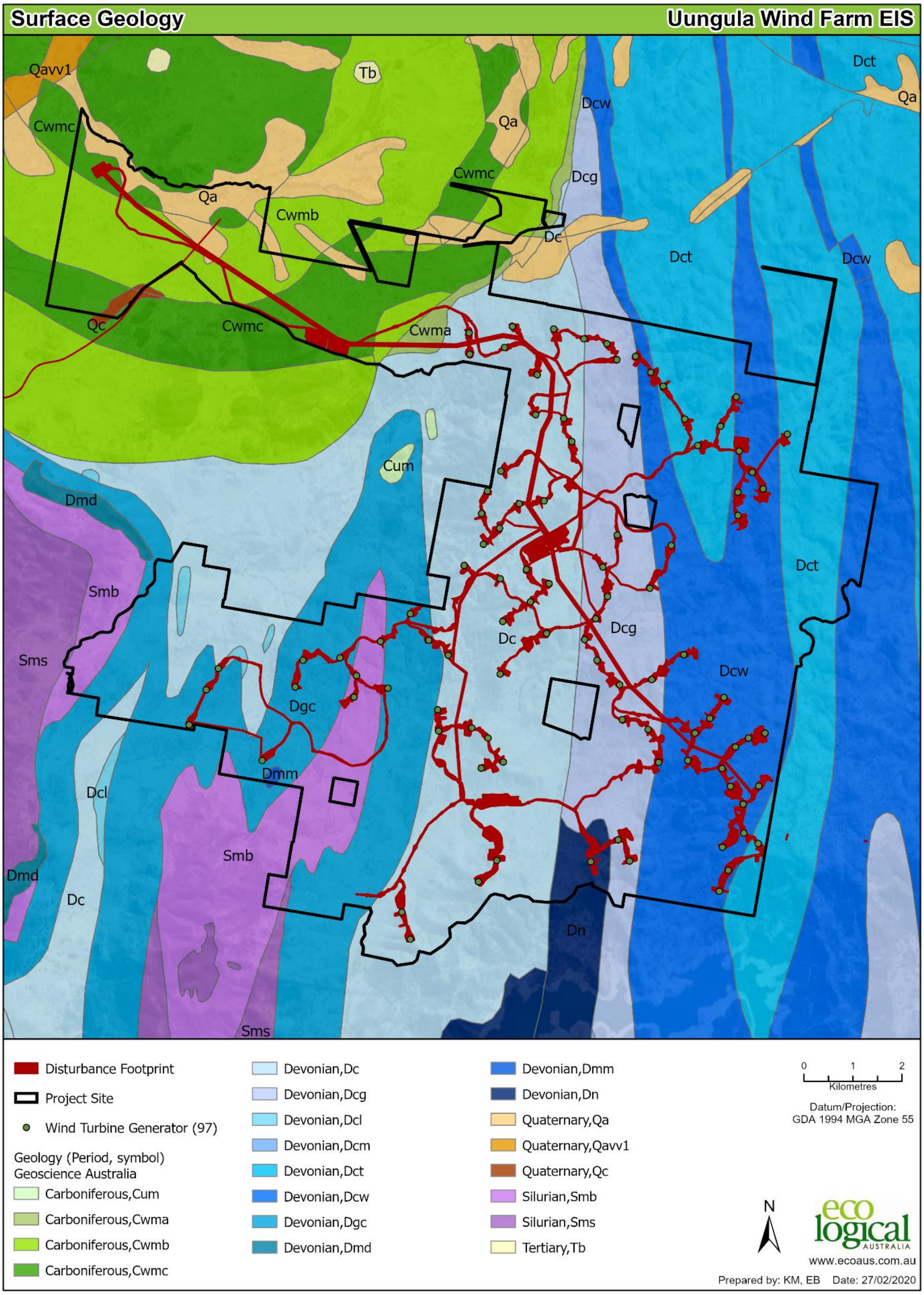


Figure 8-43: Map of Regional Surface Geology

Table 8-40: Geological units intersected by the disturbance footprint, and/or the Project Site

#	Unit name/ group	Period	Dominant lithology	Formation Process	Description
Cwma	Wuuluman Granite formation (a)/ unknown	Carboniferous	granite	dyke	Leucocratic aplitic 1-2 mm granite as discontinuous marginal phase, accessory biotite, muscovite
Cwmb	Wuuluman Granite formation (b)/ unknown	Carboniferous	monzodiorite	groundwater modification	Quartz monzodiorite (3-8 mm) with 10 percent feldspar megacrysts, accessory biotite, hornblende, sphene
Cwmc	Wuuluman Granite formation (c)/ unknown	Carboniferous	monzodiorite	groundwater modification	Quartz monzodiorite (3-8 mm) with 5 percent megacrysts, accessory biotite, hornblende, sphene
Dc	Undifferentiated / Crudine Group	Devonian	sandstone & siltstone	deep marine turbidite fan distal to active volcanism	Thickly to thinly bedded, muddy lithic, vitric, crystal volcaniclastic sandstone interbedded with siltstone and phyllitic shale; minor conglomerate (equivalent to waterbeach, Guroba and Merrions Formations, undifferentiated)
Dcg	Guroba Formation / Crudine Group	Devonian	sandstone	deep marine turbidite fan proximal to active volcanism	Thinly to thickly bedded, muddy, crystal-lithic, rhyolitic to rhyodacitic volcaniclastic sandstone interbedded with lesser tuff, siltstone, phyllitic shale and paraconglomerate
Dcl	Unnamed Formation / Crudine Group	Devonian	sandstone, marl, limestone	deep marine carbonate fan	Calcareous sandstone, marl and allochthonous limestone blocks
Dct	Turondale Formation / Crudine Group	Devonian	sandstone	deep marine turbidite fan proximal to active volcanism	Thickly bedded, crystal-lithic, rhyolitic to rhyodacitic volcaniclastic sandstone interbedded with lesser thinly bedded, pelagic and volcaniclastic sandstone, siltstone and phyllitic shale; minor rhyolitic
Dcw	Waterbeach Formation/ Crudine Group	Devonian	slate, siltstone, shale	quiet, deep marine	Well-bedded to laminated slate, siltstone and phyllitic shale, with lesser lithic, feldspathic sandstone

#	Unit name/ group	Period	Dominant lithology	Formation Process	Description
Dgc	Cuga Burga Volcanics / Gregra Group	Devonian	latite & volcaniclastics, basaltic andesite to west	submarine to subaerial volcanic centres encircled by volcaniclastic aprons	Latitic, crystal-lithic sandstone, breccia, siltstone, tuff; latite and lesser andesite, basalt; minor allochthonous limestone, quartzose sandstone
Dmm	Unnamed / unknown	Devonian	monzodiorite	shallow dykes, sills and stocks	Mela-Monzodiorite, quartz monzodiorite intrusive sills and stocks. **Only in Site - Not in disturbance footprint.**
Dn	Cunningham Formation/ unknown	Devonian	phyllite, slate, shale, siltstone, sandstone, tuff	deep marine basin	Phyllite, slate, shale, siltstone, quartz-feldspar-lithic- calcareous sandstone, tuff
Qa	Unnamed / unknown	Quaternary	silt, clay, sand	perennial to intermittent fluvial	Alluvial silt, clay and sand, variable humic content, sporadic pebble- to cobble-sized unconsolidated conglomeratic lenses
Qc	Unnamed / unknown	Quaternary	gravel, sand, silt, clay	alluvial fans and braidplains	Colluvial polymictic gravel, sand, silt and clay; may include some eluvial in situ regolith deposits
Smb	Barnby Hills Shale / Mumbil Group	Silurian	shale, siltstone		Poorly bedded to laminated, buff to brown to grey, quartzose shale and siltstone; minor rhyolitic tuff and tuffaceous sandstone; calcareous sandstone and siltstone
Smd	Dripstone Formation / Mumbil Group	Silurian	tuff, sandstone, siltstone, lava, limestone	shallow marine to (?)subaerial volcanic centre and proximal facies	Rhyolitic to felsitic tuff and tuffaceous sandstone; siltstone; mafic to felsic lava; limestone. **Not in Site – only in disturbance footprint.**
Smq	Narragal Limestone / Mumbil Group	Silurian	limestone, siltstone	supratidal to shallow subtidal	Massive to bedded highly fossiliferous limestone; siltstone. **Not in Site – only in disturbance footprint.**
Sms	Gleneski Formation / Mumbil Group	Silurian	rhyolite, latite, tuff, sandstone	shallow- rather deep marine turbidites proximal to volcanic centre	Rhyolitic to latitic lava, intrusion and tuff and volcaniclastic sandstone

8.9.2.10 Groundwater

The Project Site falls within the Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater 2012 (NSW DPI Office of Water, 2012). The Plan manages the LFB groundwater source which underlies this Project Site (Morgan et al, 1999). The LFB fractured rock aquifer is likely to be the most significant groundwater resource beneath the Project Site and surrounding area. Groundwater is also likely to be present within any alluvial deposits associated with nearby creeks. The unmapped alluvial sediments associated with unregulated rivers and creeks, as well as porous rock sediments that occur within predominantly fractured rock groundwater sources, are also managed by the Plan (NSW DPI Office of Water, 2012).

As per Section 8.9.2.9, the dominant surface geology at the Project Site is Devonian-aged units of slate, siltstone and shale with lesser lithic sandstone. There are Carboniferous volcanic intrusions to the north west of the Project Site with small areas of alluvial silt, clay and sand with some alluvial regolith deposits. To the south west of the Project Site, there are older (Silurian-aged) shales, siltstones and calcareous sandstones.

The LFB groundwater source thus likely comprises fractured aquifers within the folded and fractured sedimentary lithological units. The eastern margin of the LFB is overlapped by Permian and Triassic units of the Sydney Basin and the northern margin is overlaid by the Mesozoic Great Artesian Basin succession. The western margin is largely covered by the mainly Cainozoic Murray Basin formations (NSW DPI Water, 2012).

The LFB groundwater source is typically recharged by direct rainfall infiltration and groundwater flows through fractures, joints, bedding plains, faults and cavities within the rock mass (NSW DPI, 2012). This groundwater source is estimated to have a low to moderate level of connection between surface and groundwater (NSW DPI Water, 2016), with estimated travel time between groundwater and surface water considered to be years to decades (NSW DPI Water, 2012).

Water quality within the LFB varies significantly based on rock type, fracture density, aquifer depth, and climate. Salinity can range across all beneficial use classes from fresh to saline. The LFB is the host rock for several ore bodies and so the background trace metal chemistry of the groundwater is likely to be heavily influenced by these deposits (NSW DPI Water, 2017).

Registered bores and standing water levels

All registered groundwater bores within a 5 km buffer of the Project Site from the BoM groundwater explorer (BoM, 2020b) are shown in Figure 8-44.

Eight registered bores were located within the sub-catchments that contain the Project Site. The elevation of the bore locations varied from 362 to 499 m AHD and are lower than the average topographic elevation of the Project Site, 543 m AHD. The bore depths vary from 7.7 m to 53.4 m below the top of casing (bToC) with most bores registered for stock and domestic water use, except for one shallow water supply bore that is non-functional and one bore for irrigation. Bore water levels were taken at time of construction and during two bores censuses in 1988 and 1999. From the records available, only three standing water level measurements were taken from seven bores from the late 1960s to the late 1990s, a period of around 30 years.

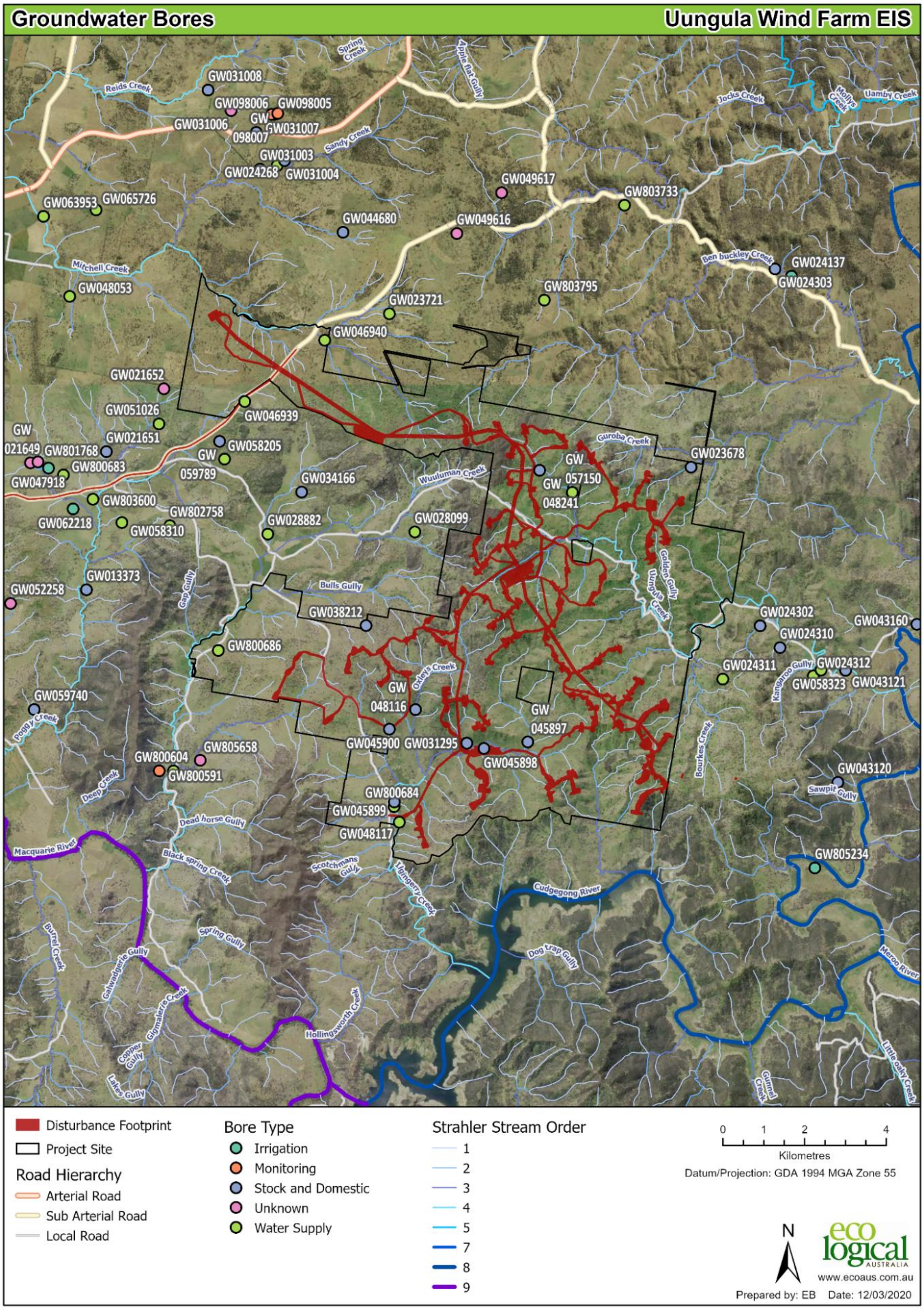


Figure 8-44: Bores within 5 km of the Project Site, and GDEs identified within and around the Project Site

Standing water level in the shallowest bore (GW028882, 7.7 mbToC) is less than 3 mbToC and likely intercepts alluvial sediments in the creek. There is insufficient water level data from bores within the sub-catchments containing the Project Site to make meaningful direct comparisons with rainfall data. However, longer water level data time series from bores near Wellington show that shallow alluvial groundwater level have a sympathetic relationship to the cumulative rainfall departure (Figure 8-45). This indicates that the water level in shallow alluvial aquifers may be expected to directly respond to rainfall.

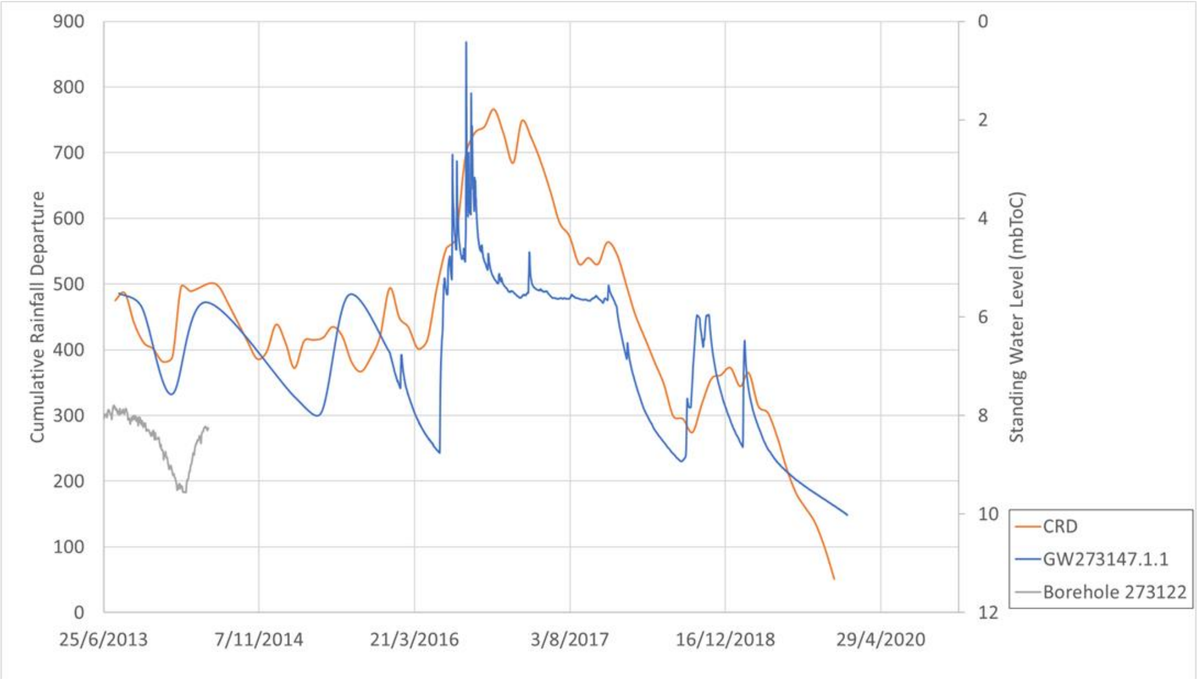


Figure 8-45: Standing water level for two bores (GW273147 and Borehole 273122) and the cumulative rainfall departure (data from BoM station 65034)

The remaining listed bores intercept the fractured rocks of the LFB and are generally overlain with less permeable layers of clay and slate (aquitards). The shallowest standing water level for the deeper bores was 0.3 mbToC, measured in 1999 (GW026328). The lithological log for this bore revealed that it intercepts underlying granitic rock, most likely the LFB aquifer. The bore is located approximately 5 km to the east of the Project Site and was the only bore on, or near, the Project Site to have standing water levels less than 3 mbToC. The bore is also one of the lowest bores in the area (at 400 m AHD), significantly below the height of the Project infrastructure.

There were only two salinity measurements from registered bores; GW031295 and GW047918. Bore GW031295 was relatively shallow (~12 m mbToC) with a water level that varied from 3.03 mbToC to 4.58 mbToC and a recorded salinity of 896 TDS, which is the equivalent to an electrical conductivity (salinity) of approximately 1500 µS/cm. This relatively high salinity would deem the water to be unsuitable for irrigation, though adequate quality for stock watering. Bore GW047918 is a deeper bore (61 m mbToC) with an electrical conductivity (salinity) of 5400 µS/cm that could potentially be used for stock watering if necessary.

Where available, standing water level data and salinity data are summarised in Table 8-41.

Table 8-41: Registered bores with standing water level and/or salinity data within 5 km of the Project Site

Bore ID	Bore depth (m)	Elevation (m AHD)	Date drilled	Aquifer	Date SWL or Salinity collected	Standing water level (mbToC)	Salinity (µS/cm)
GW023678	16.4	462.1	1966	Diorite	01/12/1966	5	
					01/12/1988	4.57	
					22/12/1999	5.5	
GW031295	12	459	1968	Slate	01/12/1968	4.58	1,500*
					01/12/1988	3.79	
					22/12/1999	3.03	
GW043121	32	362	unknown	Sandstone	01/12/1975	4	
					01/12/1988	3.3	
					22/12/1999	3.55	
GW048116	53.4	447.8	1977	Basalt	01/12/1977	6.46	
					01/12/1988	3.33	
					22/12/1999	5.7	
GW038212	44.1	499.2	1974	Shale/Schist	01/12/1974	9.5	
					01/12/1988	5.07	
					22/12/1999	12.15	
GW028882	7.7	440.3	1969	Alluvial	01/12/1969	2.33	
					01/12/1988	2.86	
					22/12/1999	1.58	
GW047918	61	441.8	1980	Basalt	18/12/1980	not measured	5,400
GW026328	22.8	400.5	1966	Diorite	1/12/1966	1.95	
					1/12/1988	2.18	
					22/12/1999	0.3	

* Converted from total dissolved solids (TDS) to EC (µS/cm) based on a multiplier of 1.67

Groundwater conceptual model

The Project Site topography consists of undulating valleys and all the registered groundwater bores within 5 km of the Project Site are located at lower elevations. The shallow water tables associated with alluvial aquifers are mainly along the valleys and could be contributing baseflow to the creeks and streams. Regional groundwater data from bores in similar landscape positions suggest that shallow groundwater is highly responsive to rainfall patterns.

The available lithological data from the local bores confirms that there are shallow alluvial sediments in some areas along creek lines. These shallow, perched aquifers may be present across the region and are likely disconnected from the deeper fractured aquifers.

Depths to water tables extrapolated beneath the ridgelines (on which the WTGs will be located) would be expected to be significantly greater than those recorded at existing bores at lower elevations. Ridges may, however, represent significant recharge zones for local aquifers, including to the deeper LFB fractured aquifers which are primarily recharged through direct rainfall.

The complex geometry of the rocks of the LFB, combined with strong fracture development means that aquifers are likely to be discordant and variable in transmissivity and storativity. Thus, similar lithologies may not create similar aquifers, aquifer yield and water quality variability. This is likely the defining feature of groundwater in the region.

8.9.2.11 Groundwater Dependent Ecosystems

Groundwater Dependant Ecosystems (GDEs) are ecosystems that have their species composition and natural ecological processes wholly or partially determined by groundwater (Geoscience Australia, 2017). The WM Act (2000) classes GDEs as “high”, “moderate” or “low” priority in terms of ecological value and, therefore, the priority for management action. The Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater identifies high priority GDEs and includes specific rules about aquifer interference activities that could negatively impact these ecosystems. No high priority GDEs have been nominated within, or adjacent to the Project Site area.

The “Riparian Lands and Watercourses Map Groundwater Vulnerability Map Sheet CL1_004” within the Wellington LEP identifies parts of the Project Footprint to contain vulnerable groundwater resources that are at risk from depletion and contamination as a result of development. Base-flow dependent, aquatic (Type 2) GDEs may be present in these areas. Areas across the region where groundwaters are fresh and shallow, deep-rooted terrestrial vegetation (Type 3) GDEs may be supported.

A high-level desktop review for potential Aquatic (Type 2) and Terrestrial (Type 3) GDEs was undertaken within the Project Site and adjacent area using the available mapped GDE information from the BoM GDE Atlas (BoM, 2017), as shown in Figure 8-46.

There were both low and high potential Terrestrial (Type 3) GDEs identified within the extent of the Project Site, as well as a small area of moderate potential for Terrestrial GDEs less than 500 m from the Project Site boundary to the north west (Figure 8-46). Potential groundwater-dependent vegetation species found in the region are listed in Table 8-42. Potential Aquatic GDEs (Type 2) were identified and coincide with creek locations.

The relatively high salinities in local groundwaters, however, and generally deeper (greater than 10 m) water tables in the fractured rock aquifers, suggests it is unlikely that terrestrial vegetation is being supported by groundwater. Shallow water tables in the alluvial aquifers suggest that vegetation along river courses may at least have a facultative (opportunistic) dependence on groundwater.

Table 8-42: Terrestrial vegetation species that potentially occur as GDEs in the Project Site, based on regional studies (BoM, 2020).

GDE	**Potentially groundwater dependent vegetation species** (Note that due to the 150 characters field limit in the GDE spatial data set, information is truncated).
High potential GDE – from regional studies	*Acacia pendula / Rhagodia spinescens, Sclerolaena acrocar / Monachather paradoxus, Chloris acrocar, Dichanthium sericeum* subsp. *sericeum*
	Angophora floribunda, Eucalyptus blakelyi, E. melliodora / A. implexa, Dodonaea viscosa subsp. *angustifolia, Bursaria spinosa* subsp. *spinosa*
	E. camaldulensis, Casuarina cunninghamiana / Callistemon sieberi, Leptospermum polygalifolium / Cynodon dactylon, Austrostipa verticillata
	E. dealbata, Callitris endlicheri, E. macrorhyncha / Styphelia acrocarp, Calytrix tetragona, A. vestita, Platysace lanceolata
	E. dealbata, E. albens, C. endlicheri, Brachychiton populneus subsp. populneus / A. implexa, Allocasuarina verticillata
	E. fibrosa, C. endlicheri / Brachyloma daphnoides subsp. *daphnoides, Leucopogon acrocarpa, Leptospermum divaricatum, Phebalium notii*
	E. macrorhyncha, Angophora floribunda, E. melliodora, E. nortonii / Cassinia quinquefaria, Hibbertia obtusifolia
	E. macrocarpa, C. glaucophylla, Allocasuarina luehmannii / Maireana microphylla, A. hakeoides, Senna form taxon *zygophylla*
	E. rossii, E. macrorhyncha, C. endlicheri, E. fibrosa / Phyllanthus hirtellus, Cassinia laevis, Pultenaea microphylla

GDE	**Potentially groundwater dependent vegetation species** (Note that due to the 150 characters field limit in the GDE spatial data set, information is truncated).
Moderate potential/ High potential GDE – from regional studies	*Geijera parviflora, E. populnea, Casuarina cristata / Sclerolaena birchii, Sclerolaena stelligera / Chloris acrocar, Enneapogon nigricans*
	E. blakelyi, E. melliodora, E. bridgesiana / A. dealbata / Themeda australis, Poa sieberiana, Bothriochloa macra
	E. conica, E.s melliodora, E. macrocarpa / Acacia deanei subsp. *deanei, Maireana microphylla, Dodonaea viscosa subsp. cuneata*
	E. melliodora / A. decora, Maireana microphylla / Bothriochloa macra, Austrostipa bigeniculata, Austrodanthonia setacea, Vittadinia cuneata

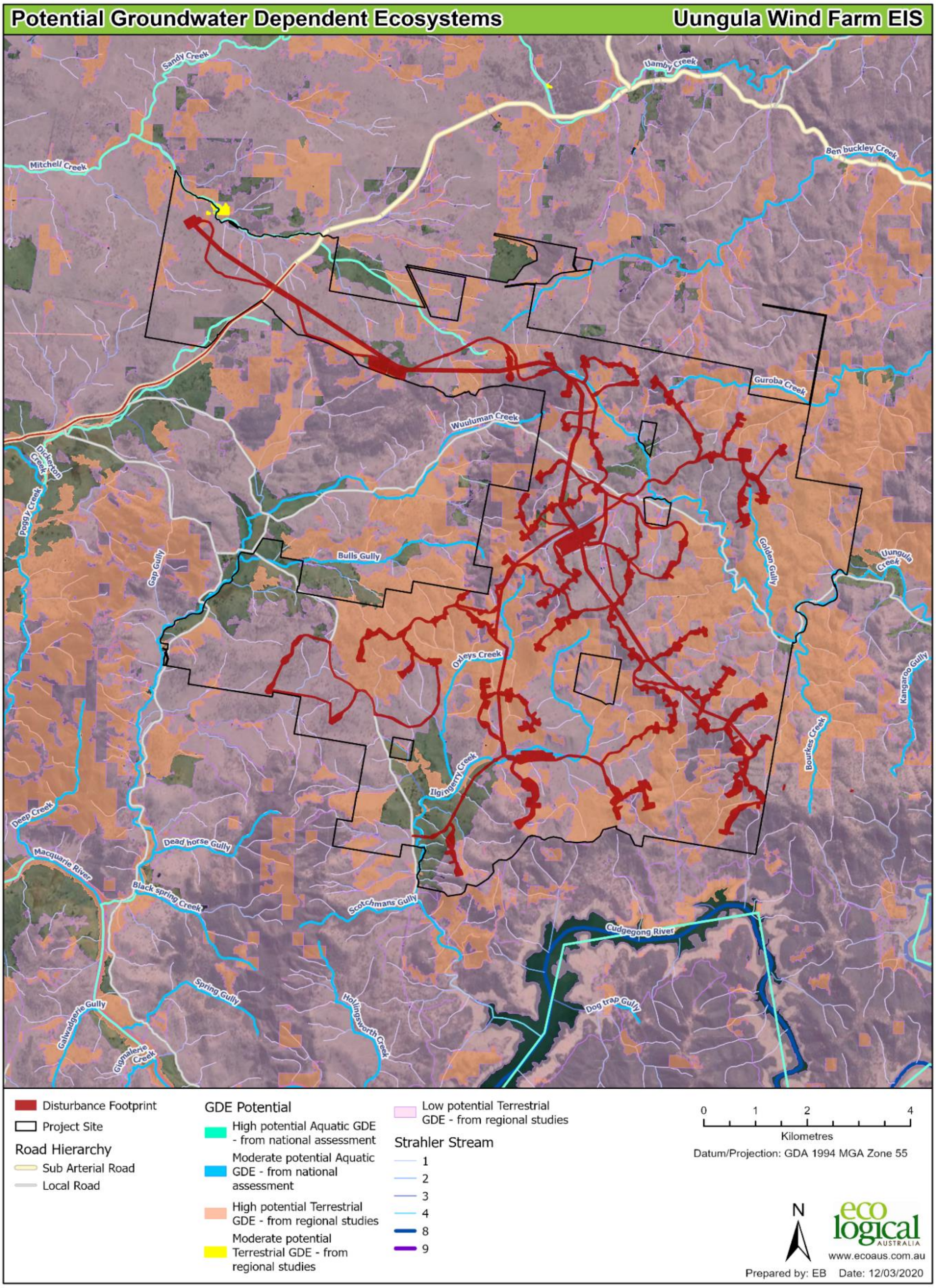


Figure 8-46: Potential GDEs identified within and around the Project Site

8.9.2.12 Soils

Soil Landscapes

The soils of the Project Site reflect the changes in climatic gradient across the ridges, and complex geology on which the soils have formed. The *Soil Landscapes of Dubbo 1:250,000 Sheet* (Murphy & Lawrie, 1998) identified eight soil landscapes occurring over the Site (Table 8-43; Figure 8-47). Descriptions of soil types mapped as occurring within each soil landscape and the project components located within each soil landscape is provided in Table 8-43. The soil type is presented as Great Soil Groups (according to the *Handbook of Australian Soils* [Stace et al., 1968]) as used for the mapping of Murphy & Lawrie (1998), as well as the equivalent Soil Order (according to the *Australian Soil Classification* system [Isbell, 2016]).

Table 8-43: Soil characteristics and project components in the Project Site

Soil Landscape	Great Soil Group (equivalent Australian Soil Classification Soil Order)	Area and associated Project Component(s)
Mookerawa	Yellow Soloths, Solodic Soils (Sodosols) Red Podzolic Soils (Chromosols, Kurosols)	Occurs within 5,000 ha of the Site, and 1,693 ha of Development Corridor containing WTGs, access tracks, powerlines, construction compound, and ESF.
Red Hill	Non-Calcic Brown Soils, Red Podzolic soils, Xanthozems (Chromosols)	Occurs within 1,611 ha of the Site, and 398 ha of Development Corridor containing 15 WTGs, and access tracks.
Wuuluman	Yellow Solodic Soils (Sodosols) Siliceous Sands (Tenosols)	Occurs within 1,392 ha of the Site, and 343 ha of Development Corridor containing a WTG, access tracks, powerlines, construction compound, and ESF.
Mullion Creek	Yellow Soloths, Red Podzolic Soil (Sodosols)	Occurs within 596 ha of the Site, and 213 ha of Development Corridor containing access tracks, powerline, construction compound, and ESF
Burrendong	Lithosols/shallow soils (Rudosols and Tenosols) Yellow Soloths, Red Podzolic Soil (Sodosols)	Occurs within 528 ha of the Site, and 118 ha of Development Corridor containing WTGs, and access tracks
Bakers Swamp	Non-Calcic Brown Soils, Euchrozems, Xanthozems, Red Podzolic Soils, Terra Rossa Soils (Chromosols)	Occurs within 119 ha of the Site, and 5 ha of Development Corridor containing access tracks
Mitchell Creek	Alluvial Soils (Chromosols)	Occurs within 68 ha of the Site only.
Glen Oak	Siliceous Sands (Tenosols) Yellow Solodic Soils (Sodosols)	Occurs within 41 ha of the Site only.

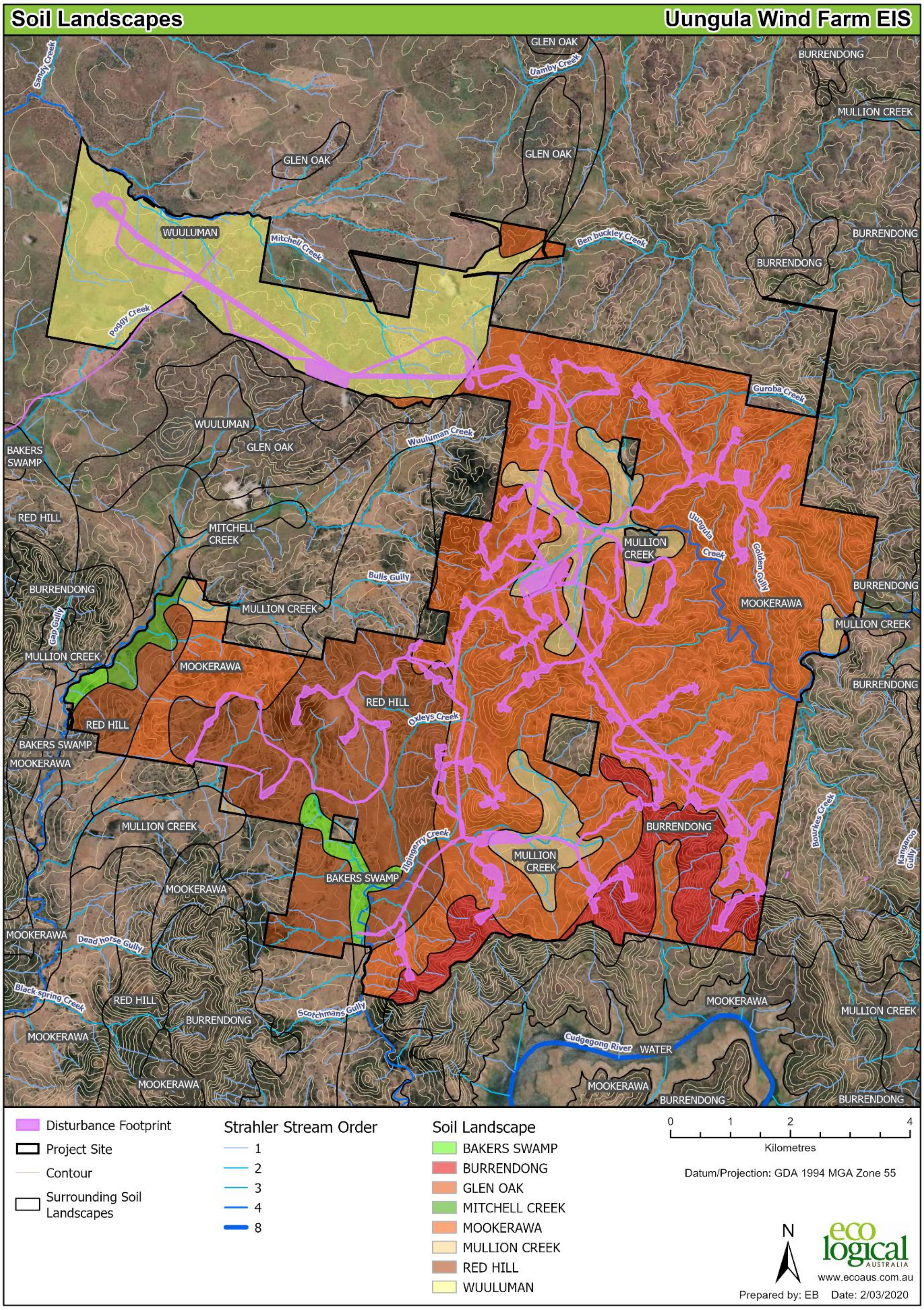


Figure 8-47: Soil Landscapes

The Mookerawa soil landscape covers the largest portion of the Project Site. This soil landscape occurs on undulating to low rolling hills and hills with slopes of 8-30% and slope lengths of 500-1,200 m. The soils are dominated by Yellow Soloths (lower slopes and drainage depressions) with Red Podzolic Soils (crests and upper slopes) also common. The Yellow Soloths have moderately acid to neutral topsoil pH, low fertility and low to moderate soil salinity. The Yellow Soloths have a high erosion hazard once surface cover is removed. These soils are Sodosols under the Australian Soil Classification (Isbell, 2016), and have strong texture contrast soil profiles with sodic and dispersive subsoils that are susceptible to tunnel formation and gully erosion (McKenzie, Isbell, Brown and Jacquier, 1999). This risk is reflected in the severe branching gully erosion that occurs in valley depressions in the Mookerawa and Mullion Creek landscapes (McKenzie, Isbell, Brown and Jacquier, 1999; Murphy & Lawrie, 1998). The slowly permeable subsoils mean that these soils may have a low trafficability after rainfall. The Red Podzolic Soils have moderately acidic topsoil pH, low to moderate fertility and low soil salinity. Slopes are sufficient to cause a moderate erosion hazard when surface cover is low or removed particularly on steeper slopes

The Mullion Creek soil landscape contains the same soil types as the Mookerawa soil landscape with Yellow Solodic soils co-dominant with similar Yellow Soloths on lower slopes and drainage depressions. The soil landscape occurs on undulating low hills with slopes generally 3-6%, but up to 12% steepness. The Yellow Soloths and Solodic Soils have a high erosion hazard with a risk of gully formation for the reasons stated above. The slowly permeable subsoils mean that these soils may have a low trafficability after rainfall. The Red Podzolic Soils have moderate erosion hazard (when disturbed). High levels of salinity are also apparent in this soil landscape given its position in the landscape (drainage lines, depressions, footslopes, lower slopes and more rarely mid/upper slopes) (Murphy & Lawrie, 1998).

The Burrendong soil landscape occurs on the rolling to steep hills with slopes 20-50% and slope lengths generally of 300-600 m. It occurs within the southern portion of the Project Site on hillcrests and upper slopes often in a topographic sequence with the Mookerawa and Mullion Creek soil landscapes on lower slopes. It is dominated by shallow Lithosols with moderately acidic topsoil pH, very low fertility and low soil salinity. Due to the steep slopes, soils have a high erosion hazard when surface cover is removed. Slopes, rock outcrops and a shortage of clay materials may be a limitation to soil conservation earthworks (Murphy & Lawrie, 1998).

The Red Hill soil landscape occurs on rolling low hills with slopes of 5-20% and slope lengths of 400-800 m. The soils are dominated by Non-calcic Brown Soils (upper mid and lower slopes) with minor areas of shallow Red Podzolic Soils and Euchrozems (crests and upper slopes). The Non-calcic Brown

Soils have slightly acidic topsoil pH, moderate fertility and low soil salinity. The Red Podzolic Soils have moderately acidic topsoil pH, moderate fertility and low soil salinity. Both soils are non-sodic and have a moderate erosion hazard if ground cover is low or removed. Problems relating to salinity are absent (Murphy & Lawrie, 1998). Sheet erosion may occur in some cultivated lands (OEH, 2010). Gully erosion may occur where drainage lines are concentrated; however, continuous ground cover vegetation reduces erosion risk.

The Glen Oak and Wuuluman soil landscapes occur in the north west are of the Project Site on Granitic parent material. The Glen Oak soil landscape occurs on undulating low hills with slopes of 5-15% and slope lengths of 200-500 m. The Wuuluman soil landscape occurs on undulating low hills with slopes of 5-8% and slope lengths of 700 to 1,500 m. Both soil landscapes have Siliceous Sands on crests and upper slopes and Yellow Solodic Soils on midslopes to drainage depressions. The Siliceous Sands have slightly acidic topsoil pH, low to very fertility and low soil salinity. The Yellow Solodic Soils have slightly acidic topsoil pH, low to very fertility and low to moderate soil salinity. The Siliceous Sands have a moderate erosion hazard when cover is removed, but the sodic Yellow Solodic Soils are highly susceptible to gully erosion.

The Mitchell Creek soil landscape is situated on the south western section of the Project Site, outside of the Project Footprint. This soil landscape occurs on alluvial plains adjacent to minor streams and creeks with slopes of <4 % and slope lengths of 50-500 m. Soil types vary depending on proximity to creek lines, but are dominated by Alluvial soils along creeks and Black, Red-brown or Red Earths and Yellow Podzlic – Solidic soils on flood plains. Soils may be prone to streambank erosion and gully formation in places (Murphy & Lawrie, 1998). Salinity can be an issue depending on the characteristics of the upstream soil landscapes.

The Bakers Swamp soil landscape occurs on undulating low hills with slopes of 6-10% and slope lengths of 500-1,000 m. Soils types are variable comprised of Red Podzolic Soils and Terra Rossa Soils (on Limestone) on Crests and upper slopes, Euchrozems and Non-calcic Brown Soils on upper slopes and side slopes and Xanthozems on lower slopes and drainage depressions. Soils are generally slightly acid to neutral (though Terra Rossa Soils on Limestone are neutral to alkaline), moderately fertile with low soil salinity. Soil erosion hazard is generally moderate where cover is removed. This soil landscape occupies 5 ha within the Project Footprint.

Land and Soil Capability

Land capability is the inherent physical capacity of land to sustain a range of land uses and management practices in the long term without degradation to soil, land, air and water resources

(OEH, 2012). The classification of any land is based on biophysical features which determine the limitations and hazards of that land. The main hazards and limitations include water erosion, wind erosion, soil structure decline, soil acidification, salinity, waterlogging, shallow soils, rockiness, and mass movement.

The *Land and Soil Capability Assessment Scheme* (OEH, 2012) is an eight-class system which recognises four types of land uses with land capability decreasing from Class 1 to Class 8:

- Class 1 – 3: land suitable for cultivation;
- Class 4 – 5: land suitable for grazing and restricted cultivation;
- Class 6: land suitable for grazing; and
- Class 7 – 8: land not suitable for agricultural production.

Land and soil capability mapping correspond to each soil landscape, based on the most limiting factor. The land and soil capability for each soil landscape is provided in Table 8-44.

The majority of the Development Corridor (75.5%) is mapped as low capability land (Class 6), covering 2,091 ha. Class 6 land has very high limitations for high impact land uses such as cropping with cultivation, and land use is restricted to grazing (OEH, 2012).

Moderate capability land (Class 4) is mapped as 12.4% of the Development Corridor. Class 4 land has moderate to high limitations for high impact land uses and will restrict land management options for regular high-impact land uses such as cropping, high-intensity grazing and horticulture with cultivation (OEH, 2012). These limitations can only be managed by specialised management practices with a high level of knowledge, expertise, inputs, investment and technology (OEH, 2012).

Moderate-low capability land (Class 5) is mapped as 7.7% of the Development Corridor. Class 5 land has high limitations for high impact land uses, and land use is largely restricted to grazing, some horticulture (orchards), forestry and nature conservation (OEH, 2012). The limitations need to be carefully managed to prevent long-term degradation (OEH, 2012).

Very low capability land (Class 7) is mapped as 4.3% of the Development Corridor. Class 7 land has severe limitations that restrict most land uses and generally cannot be overcome (OEH, 2012). On-site and off-site impacts of land management practices can be extremely severe if limitations are not managed; as such, there should be minimal disturbance of native vegetation (OEH, 2012).

Table 8-44: Land and soil capability classes within the Project Site

Hazard Classification	Soil Landscape							
	Mookerawa (5,000 ha)	Red Hill (1,611 ha)	Wuuluman (1,392 ha)	Mullion Creek (596 ha)	Burrendong (528 ha)	Bakers Swamp (119 ha)	Mitchell Creek (68 ha)	Glen Oak (41 ha)
Soil Acidification	5	3	4	4	5	3	3	4
Water Erosion	6	6	4	5	7	3	2	5
Soil Structure Decline	4	3	3	4	3	3	4	3
Wind Erosion	4	2	3	3	3	2	2	3
Shallow soils/ Rockiness	3	3	3	2	6	1	1	6
Salinity	3	1	3	3	1	3	3	1
Mass Movement	1	1	1	1	7	1	1	1
Water-logging	2	1	2	3	1	2	2	2
Land and Soil Capability Class	**6**	**6**	**4**	**5**	**7**	**3**	**3**	**6**
Capability	**Low**	**Low**	**Moderate**	**Moderate - Low**	**Very Low**	**High**	**High**	**Low**

Source: Land and Soil Capability Mapping for NSW (OEH, 2017a)

A small area of the southern portion of the Development Corridor is mapped as high capability land (Class 3), covering 5 ha. Class 3 land has moderate limitations for more intensive uses other than grazing and cropping with cultivation, and suitability for a variety of land uses can be maintained if carefully managed to prevent long-term degradation (OEH, 2012).

Draft Important Agricultural Land (IAL) mapping has not yet been released for the Central West and Orana Region; however, as the Project Site does not contain Class 1 or Class 2 land and only 5 ha of Class 3 land, the Project Site is not considered to contain any IAL.

Soil Condition and Land Management

Results from 2008-09 monitoring, evaluation and reporting program, undertaken as part of the 2009 State of the Environment report (OEH, 2014), reveal that the overall soil condition index for the Central West Catchment Management Authority (CMA) region is 3.8 (Fair) indicating that there is a noticeable loss of soil function and deterioration against reference condition. The identified broad issues of concern are sheet erosion and salinity (OEH, 2014). Hydraulic modelling found the Project Site is not prone to sheet erosion due to the site’s high relief terrain concentrating flows into valleys. Further, evidence of sheet erosion and salinity were not observed within the Project Site during site inspections.

The overall land management within capability index for the Central West CMA region is also 3.8 (fair) indicating that land is managed within capability and there is an acceptable risk of soil and land degradation, while the broad issue of concern in relation to land management was salinity/waterlogging – particularly within Soil Monitoring Unit 1 (Hill End Trough) which is associated with the majority of the Project Site (OEH, 2014).

8.9.2.13 Erosion Potential

The desktop assessment undertaken uses some erosion data based on ‘bare earth’ scenarios (i.e. nil vegetative cover). The groundcover within the Project Site is typical of that located in an agricultural landscape, with a high proportion of the Project Site vegetated by grasses, sedges, and herbs. Given this, the existing erosion potential of the Project Site may be reduced when consideration is given to current groundcover and land management practices.

Climate

Climate factors are a major influence on the character and potential hazards of any development site, including erosion and plant growth potential (DLWC, 2000). Climate is discussed earlier in this chapter.

Soil Erodibility and Dispersibility

Soil erodibility is the measure of the susceptibility of individual soil particles to detachment and transport by erosive agents such as water and wind. Erodibility is influenced by the chemical, physical and mechanical properties of the soil. Generally, the erodibility of the surface soil and subsoil differ; surface erodibility primarily relates to sheet and rill erosion, while subsoil erodibility relates to gully erosion (Murphy and Lawrie, 1998).

Modelled Exchangeable Sodium Percentage (ESP) at the Project Site ranges between 2 – 8% in soil 0 – 30 cm deep and 2 – 10% in 30 – 100 cm soil depth (OEH, 2017b). In Australia, soil sodicity is defined as an ESP of >6% (Isbell, 2016). Modelled ESP of the site and the *Soil Landscapes of Dubbo 1:250,000 Sheet* mapping indicate the subsoils across much of the Project Site are sodic. Soils with sodic subsoils dominant or co-dominant in the Mullion Creek, Mookerawa, Wuuluman and Glen Oak soil landscapes. Sodic soils tend to be dispersive and are susceptible to tunnel formation and gully erosion when exposed to rainfall or runoff (OEH, 2010; Murphy & Lawrie, 1998). Topsoils are moderately sodic in where Soloths and Solodic soils have been identified and mapped, and non-sodic where other soils have been mapped. Topsoil sodicity can lead to a loss of soil structure, slumping and surface sealing leading to increased runoff and accelerated sheet and rill erosion. Whilst soil mapping indicates that some soils at the Project Site are sodic, no evidence of sheet or significant gully erosion was recorded within the Project Site during site inspections due to the lack of soil cultivation and the presences of intact groundcover (generally >70%).

Rainfall Erosivity

Rainfall Erosivity (also called the R-factor) is a measure of the ability of rainfall to cause erosion and is calculated based on total energy and maximum 30-minute storm intensity (Landcom, 2004). The R-factor varies between 600 (low) in parts of western NSW to over 10,000 (high) on the far north coast of NSW.

The R-factor for the Project Site is approximately 1,250 – 1,500 based on *Rainfall Erosivity Values for New South Wales 1: 250,000 Topographic Sheet in Appendix B* of the 'Blue Book' (Landcom, 2004). Given this range the R-factor for the Project Site can be considered relatively low.

Soil Erosion Hazard

Soil erosion hazard refers to the susceptibility of a parcel of land to the prevailing agents of erosion and is typically described as high to low erosion hazard (Landcom 2004). Soil erosion hazard determination is dependent on a combination of factors: soil erodibility (inherent susceptibility to water erosion), climate (Rainfall Erosivity), landform (slope angle and length), groundcover and land management factors (Landcom, 2004). Therefore low soil erosivity does not necessarily equate to a low erosion hazard if the slopes are steep and ground cover is removed. Sites with high erosion hazard may require control measures beyond the normal suite of erosion control measures applied to construction sites. Sodic soils that commonly occur at the Project Site have a high erosion hazard and require careful management to prevent severe gully erosion.

The slope angle and slope length of the ridges and valleys are major contributing factors in determining soil erosion risks. Areas within the Development Footprint have slopes between 8 – 30% but are generally less than 15%. Sheet erosion[10] may occur on the shallow slopes and plains; however, where steeper slopes and/or sodic subsoils (soils with a high exchangeable sodium percentage) are present, there is a greater potential for rill or gully and tunnel erosion. Once exposed by removal of topsoil or excavation, dispersible sodic subsoils can erode rapidly to develop areas of severe gully erosion. Areas with the steepest slopes on the Project Site have a severe soil erosion hazard when surface cover and or topsoil is removed. Under current land management, the groundcover contains a mix of perennial and annual pasture species and some trees that provide additional protection of the moderately sodic topsoil and sodic subsoils. As such, through the design process, WTG infrastructure has been positioned on cleared areas with good existing groundcover and shallower slopes within the topographic constraints of each work site where possible.

Soils that shrink or swell significantly depending on changes in their moisture content are called expansive or reactive soils. Soils that typically exhibit shrink-swell properties (or 'cracking') to varying degrees have been identified within the Project Site (see Table 8-45) and may be problematic in structures such as sediment basins, roads and foundations (Landcom, 2004).

The Dubbo soil report (Murphy & Lawrie, 1998) classifies erosion hazards based on 'bare earth' scenarios under standard agricultural land management practices for soil landscapes as summarised in Table 8-45. Note that any form of soil disturbance means all soils will be more prone to erosion and that the risk to erosion increases as slope >3%.

[10] Sheet erosion is the uniform removal of soil in thin layers by the forces of raindrops and overland flow. It can be an important erosive process because it can cover large areas of sloping land and go unnoticed for quite some time.

Table 8-45: Erosion and movement soil hazards by soil landscape

Soil Landscape	Soil Sub-type	Hazard Classification					
		Erodibility (topsoil)	Erodibility (subsoil)	Erosion Hazard	Structural Degradation Hazard	Shrink-swell Potential	Mass Movement Hazard
Mookerawa	Yellow Solodths	Mod-High	High	High	High	Moderate to low	Low
	Red Podzol-ic soils	Moderate	Moderate	Moderate	Moderate to High	Moderate to low	Low; minor slumping
Red Hill	Non-calcic Brown Soils	Low	Low	Moderate	Moderate	Moderate	Low
	Red Podzol-ic soils	Moderate	Low	Moderate	High	Moderate	Low
Wuuluman	Siliceous Sands	Moderate	Moderate	Moderate	Moderate to high	Very Low	Low
	Yellow Sodolic Soils	Moderate	High	High	Moderate to high	Low	Low
Mullion Creek	Yellow Solodths	Moderate	High	High	High	Low to moderate	Nil
	Red Podzol-ic Soils	Moderate	Moderate to high	Moderate to high	High	Moderate	Nil
Burrendong	Shallow Soils	Moderate	Low	High	High	Low	Moderate
	Red Podzol-ic Soils	High	Moderate	High	High	Moderate	Low
	Yellow Solodths	High	High	High	High	Moderate to low	Low
Bakers Swamp	Non-calcic Brown Soils	Moderate	Low	Moderate	Moderate to high	Moderate to high	Low
	Euchrozems	Low	Low	Moderate	Moderate	Moderate to high	Low
	Xanthozems	Moderate	Low	High	Moderate to high	Moderate	Low
	Red Podzol-ic Soils	Moderate	Low	Moderate	High	Moderate	Low
	Terra Rossa Soils	Low	Low	Moderate	Moderate	Low to Moderate	Low

Soil Landscape	Soil Sub-type	Hazard Classification: Erodibility (topsoil)	Erodibility (subsoil)	Erosion Hazard	Structural Degradation Hazard	Shrink-swell Potential	Mass Movement Hazard
Mitchell Creek	Soils are highly variable, and characteristics are not listed in detail. They share qualities with adjacent, upstream and downstream soil types.						
Glen Oak	Siliceous Sands	Moderate	Moderate	Moderate	Moderate	Very Low	Low to moderate
	Yellow Solodic Soils	Moderate	High	High	Moderate	Low	Low

8.9.2.14 Other local environmental constraints

Salinity

Salinisation is often the result of clearing of deep-rooted native vegetation and establishing shallow-rooted crops and pastures that take up less water leading to rising groundwater brining dissolving salts stored in the soil to the surface (OEH, 2018b). Impacts to the environment include decreased plant growth resulting in reduced groundcover and increased susceptibility to erosion, as well as off-site impacts from salt export to wetlands and rivers (OEH, 2019). Salt accumulation in soils can have adverse impacts on developments including damage to building foundations, breaking up road pavements and corrosion of underground pipes and services (Landcom, 2004). In all landscapes, salts are typically restricted in localised drainage depressions and adjacent to soil profile texture changes and are often the result of evaporative concentration of salts at waterlogged sites. The *Hydrogeological Landscapes for the Western Central West Catchment* (Wooldridge *et al.*, 2012) identified the following hydrogeological landscape systems (HGLS) as occurring over the Project Site:

- HGLS10 - Wuuluman;
- HGLS33 - Euchareena;
- HGLS34 - Stuart Town;
- HGLS9 - Curga Burga Volcanics;
- HGLS7 - Turtle;
- HGLS28 - Goolma; and
- HGLS29 - Biranganbil.

The overall salinity hazard, and characteristics of each HGL are provided in Table 8-46.

Table 8-46: Salinity hazard within the Project Site (Wooldridge et al., 2012; OEH, 2016; OEH, 2015)

Hydrogeological Landscape	Salinity Expression	Salt Mobility	Overall Hazard
10 - Wuuluman	**Land Salinity Occurrence:** Low – The landscape is characterised by multiple localised small areas (<0.5 Ha) of land salinisation. These occur in the upper parts of the landscape at the change in slope, at breaks in slope down the sequence and commonly at the contact between the colluvial slopes and alluvium in the valley floor. **Salt Load (export):** Moderate – This landscape is a moderate contributor to salt load in streams. **EC (water Quality):** High – Streams typically have low ECw (<2dS) with occasional spikes of moderate ECw 2-4dS.	Low – There is a low salt store that has moderate availability.	Moderate
33 - Euchareena	**Land Salinity Occurrence:** Low – Localised salt sites associated with sodic sites occur in flow lines. Highly erodable landscapes with significant gully erosion and small sites exist throughout the area due to high sodicity. Some salt sites around quartz veins (1-2m wide) and in gullies that extend to top of ridges in this very infertile, erosive landscape. **Salt Load (export):** Low – Load is low from this landscape with inconsistent flow and limited connection to the water table. Larger component of run-off acts as a dilution flow. **EC (water Quality)** High – Low EC <2 dS with minor spikes that rarely trend up to 4dS.	Moderate – There is a low salt store that has high availability.	Moderate
34 - Stuart Town	**Land Salinity Occurrence:** Moderate – Moderate sized (2- 5ha) salt sites occur in this landscape with strong structural control. The landscape has broader basins than Euchareena HGLS. Most sites are associated with faults, fractures and minor quartz veins. **Salt Load (export):** Moderate – Salt load is moderate from this landscape with inconsistent flow and limited connection to the water table. Large component of sub-surface flow rather than runoff into creeks. Relatively constant flow from the landscape with moderate salt store and significant load. **EC (water Quality):** Moderate – Moderate ECw >4 dS with minor spikes that up to 8dS ECw.	High – There is a moderate salt store that has high availability.	High

Hydrogeological Landscape	Salinity Expression	Salt Mobility	Overall Hazard
9 - Curga Burga Volcanics	**Land Salinity Occurrence:** High – There are large saline sites (up to 90 ECe) with a large proportion (40%) of the catchment affected. Sites occur at constrictions, along and associated with faults. This is a very salty landscape. **Salt Load (export):** High – This landscape has high salt export with high load. Large saline sites have a high wash off with quick connection to streams. Salt store in soils is also high so has input to stream for longer periods. **EC (water Quality):** Low – This landscape typically has high EC values with spikes up to 16 dS. Groundwater salinities may reach 40 dS. This is a major contributor to EC spikes in the local catchment and the broader catchment.	High – There is a high salt store that has moderate availability.	Very High
7 – Turtle	**Land Salinity Occurrence:** High – There are seasonal large sites (up to 40 ECe) that occur at the metamorphic contact in wet times. The metamorphic contact does not exhibit land salinisation symptoms, but does have an extreme EM signature. This is a very salty landscape. **Salt Load (export):** High – There is a high load export, particularly in wet times. This unit provides saline base flow to local permanent creeks. **EC (water Quality):** Low – This landscape provides high EC with extreme spikes (15 dS) to local streams. Streams routinely run at high EC (4 and 6 dS).	High – There is a high salt store that has high availability.	Very High
28 – Goolma	**Land Salinity Occurrence:** High – On steeper slopes in this HGLS, localised salt sites occur in the colluvium and at structural features e.g. faults. Large salt sites form at break-of slope and lower colluvial slopes. Soil ECe up to 50dS occurs on severe sodic and saline sites. **Salt Load (export):** High – Load is extremely high in this HGLS due to high salt storage in these landscapes. There is high connection between salt store and surface hydrology. This hazard is exacerbated by inappropriate land use in the lower parts of the landscape. **EC (water Quality):** Low – High EC in streams is a significant issue, with high (4-8dS ECw) to extreme (>8dS ECw) occurring. Large salinity spikes of up to 18dS/m ECw occur in events which last from days to weeks.	High – There is a high salt store that has high availability.	Very High

Hydrogeological Landscape	Salinity Expression	Salt Mobility	Overall Hazard
29 - Biranganbil.	**Land Salinity Occurrence:** Moderate – Localised small salt sites (<2Ha) occur high in the landscape and moderate seasonal sites (2-4 ha) occur lower in the landscape. Acid sulphate sites occur at geological contacts, usually in the mid-slope location. Sites produce severely saline soils that are black in subsoils, strong pungent odour ('rotten egg' gas) and with very severe effects on plants. These 'black' sites commonly have a 'pollution plume' that kills vegetation on downstream side for considerable lengths in wet times. **Salt Load (export)** Moderate – This landscape produces moderate to high salt load in wet times, particularly from the sites at the contact areas. High relief landscape, so a relatively constant flow of 1-3dS ECw from higher sites and 6-8dS ECw and pH 3.5-5.5 from the lower sites. **EC (water Quality)** Moderate – The water quality varies considerably. If the system is wet, the acidic water has major impacts on aquatic biodiversity in streams (1-3dS ECw from higher sites and 6-8dS ECw and pH 3.5-5.5 from the lower sites).	Moderate – There is a moderate salt store that has moderate availability.	Moderate

Contaminated Land

A review of the EPA Contaminated Land Record under section 58 of the CLM Act and the List of NSW contaminated sites notified to the NSW EPA under section 60 of CLM Act did not reveal any registered contaminated land sites within or surrounding the Project Site (EPA, 2020).

A review of premises currently regulated by an EPL under the POEO Act and premises that are no longer required to be licensed under the POEO Act did not reveal any identified premises within or surrounding the Project Site.

Pursuant to Clause 7 of SEPP 55, no documented evidence has been found that indicates that land to be utilised by the Project would be contaminated. Whilst no registered contaminated land occurs within the Project Site, potential contamination associated with agricultural activities may exist on site. These include sheep dips, import and fill material, demolition of old buildings and stockpiling of wastes.

Acid Sulfate Soils

The Australian Soil Resource Information System (ASRIS) online data base indicates that there is a low probability of occurrence (6 – 70% chance) of potential acid sulfate soils at the majority of the Project Site, and an extremely low probability of occurrence (1 – 5% chance, with occurrences in small localised areas) of potential acid sulfate soils at the remainder of the Project Site (Figure 8-48; Fitzpatrick, Powell & Marvanek, 2011). However, the Biranganbil HGLS29 contains a high hazard for inland acid sulfate processes low in the landscape associated with structural features (OEH, 2016). Both datasets are inferred from surrogate datasets. The confidence level of the ASRIS map polygon overlaying the Project Site (very low confidence) indicates the classification is provisional due to no analytical data available or ground truthing. The Confidence level of the Biranganbil HGL is high. Inland acid sulfate soils occur on inland waterways, wetlands and drainage channels, and develop in waterlogged, saline and anaerobic conditions.

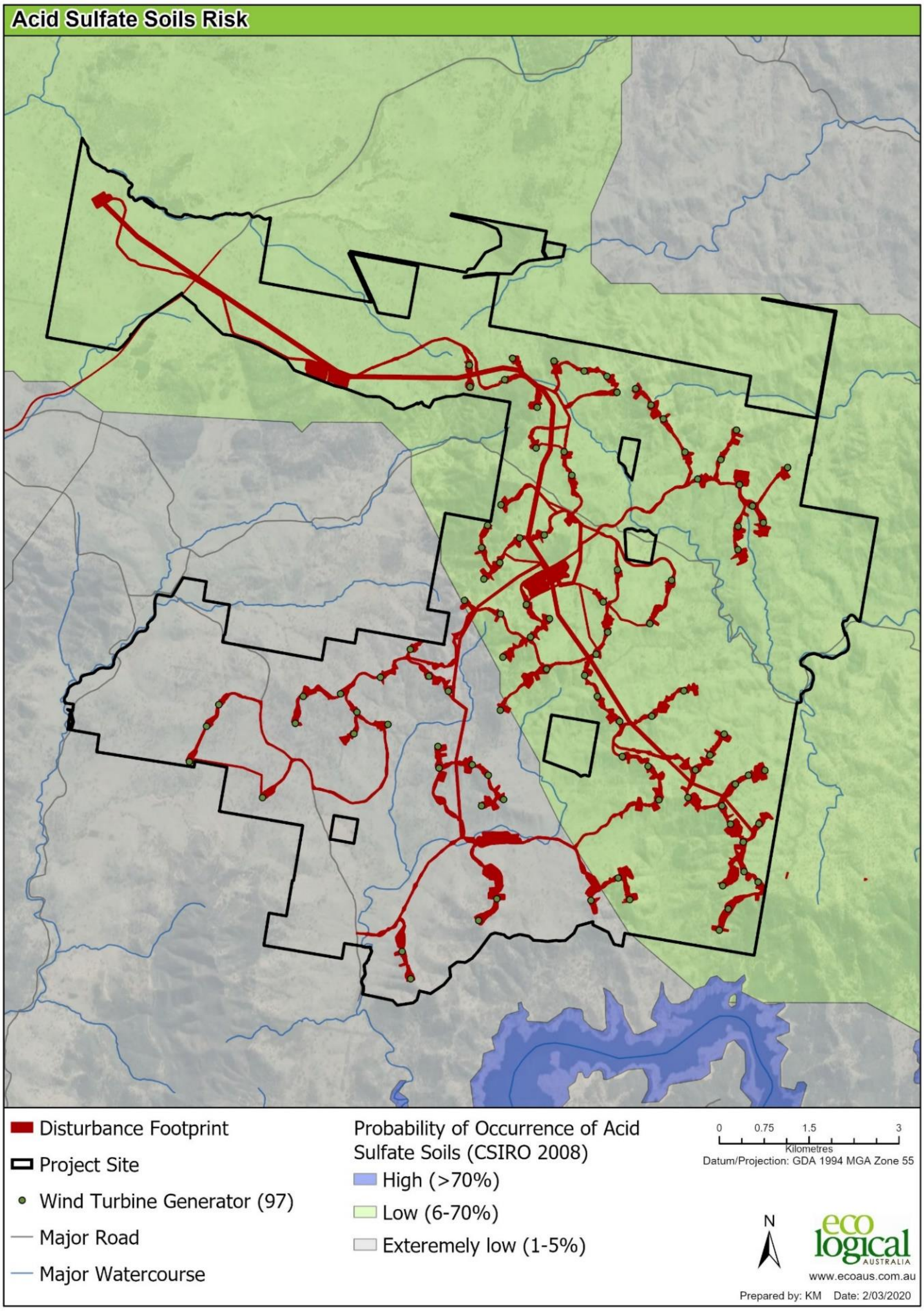


Figure 8-48: Potential acid sulfate soils at the remainder of the Project Site (ASRIS)

Biophysical Strategic Agricultural Land (BSAL)

No areas of high agricultural value have been identified and mapped as BSAL within the Project Site. The closest mapped area of BSAL is located approximately 3.5 km west of the Development Corridor (2.7 km from the Project Site) towards Wellington.

Mining & Exploration

A search of the NSW MinView portal (DPIE, 2020) was undertaken on 23 April 2020. Three Exploration Licence (EL) and two Exploration Lease Application areas exist within the Project Site, and no active mining leases exist within or nearby the Project Site (Figure 8-49). EL8212 (valid until 12/12/2025) and EL8252 (valid until 01/04/2023) are held by Endeavour Minerals Pty Ltd, EL8505 (expired 06 February 2020, renewal sought) is held by Drummond West Pty Ltd, ELA5852 was applied for by Syndicate Minerals Pty Ltd on 09/09/2019, and ELA5857 was applied for by Monzonite Metals Pty Ltd on 10/09/2019.

As discussed in Section 6.4.3, the Proponent has consulted with the relevant Title Holders of mineral exploration leases and mining licences within the Project Site since 2013. In early 2020, the Proponent consulted with titles agents of Minerals Title holders (Endeavour Minerals Pty Ltd, Drummond West Pty Ltd, Syndicate Minerals Pty Ltd, and Monzonite Metals Pty Ltd) advising of the Project and providing maps of Project layout and overlapping Exploration Licences / Exploration Licence Applications as shown in Figure 8-49.

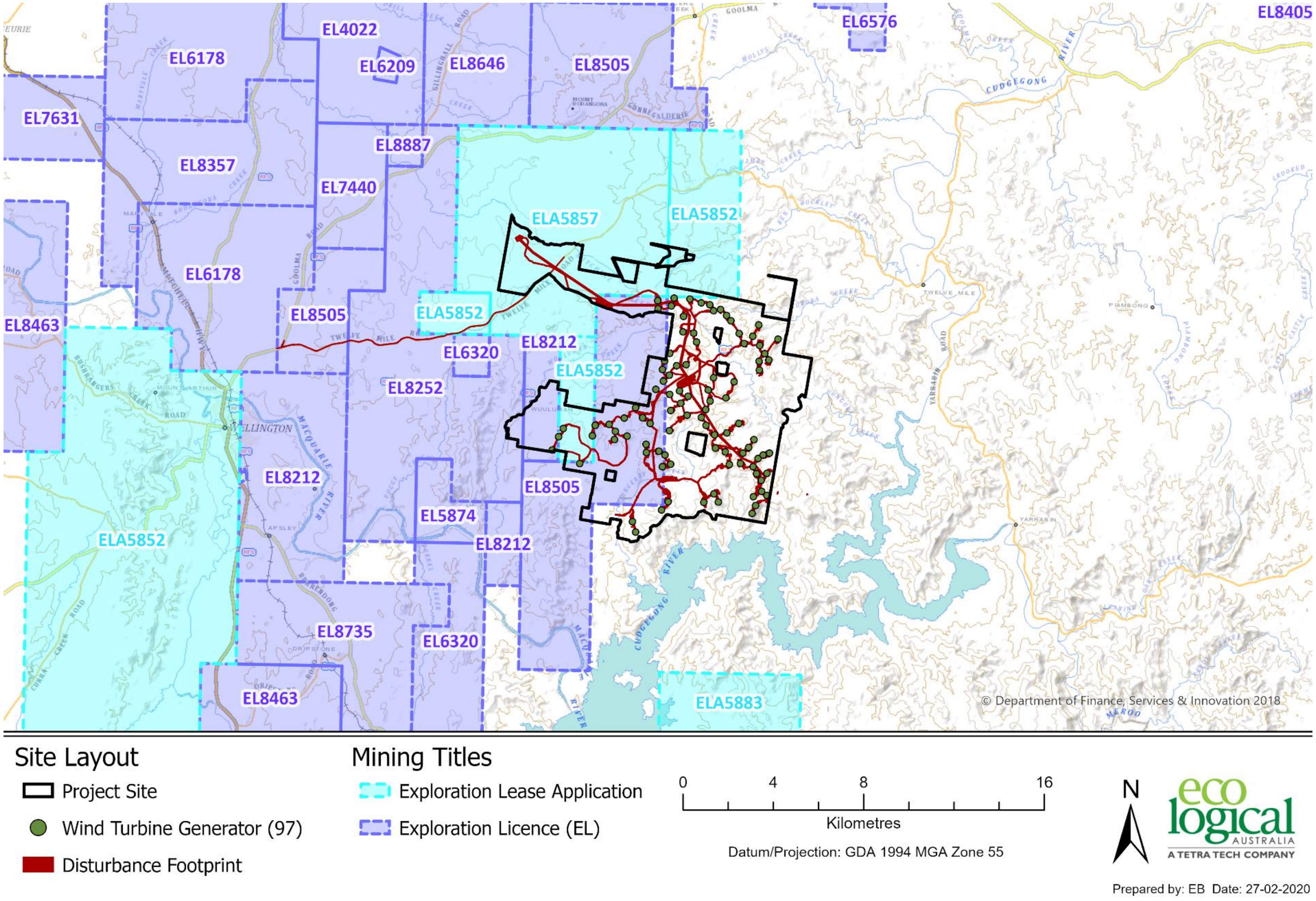


Figure 8-49: Mining titles context (DPIE, 2020)

8.9.3 Potential Impacts

Potential impacts to soil landscapes, water quality, hydrology, aquatic ecosystems, GDEs and groundwater resources during construction (including decommissioning) and operational phases are considered in the following sections. Mitigation and management measures are provided in Environmental Management (Section 9) as Statement of Commitments WS001, WS002, WS003, WS004, WS005 and WS006.

8.9.3.1 Land use

The Project involves a temporary diversification in land use of up to 2,770 ha (Development Corridor), accounting 0.01% of all land used for agriculture in the ABARES Far West and Orana region, for the duration of the project life. This changed land use may temporarily reduce agricultural production. However, once constructed, grazing will continue within the Project Site to control vegetation, allowing for the continuation of existing agricultural activities. Therefore, impacts of the Project on agricultural production at a regional level are very minimal. At the conclusion of the life of the project, the Project would be decommissioned in order to permit the resumption of grazing activities or other agricultural uses.

The entire Project Site and surrounding land is zoned RU1 Primary Production. An assessment of the Project's compatibility with the objectives of the RU1 zone is provided in Table 8-47.

Table 8-47: Compatibility of the Project with the RU1 zone objectives (Wellington LEP 2012)

Objective	Project
To encourage sustainable primary industry production by maintaining and enhancing the natural resource base	The Project Footprint accounts for 0.37% of all land within the Dubbo Regional Council LGA and will not substantially reduce the availability of agricultural land within the LGA. Furthermore, the Project allows for the continuation of livestock grazing because of the sparse nature of the distribution of the WTGs. Following decommissioning (approximately lifespan of 30 years) the land will be rehabilitated back to its current use for agriculture.
To encourage diversity in primary industry enterprises and systems appropriate for the area	Wind harvesting is a passive land use that can co-exist with sheep and cattle grazing. The Project will support the growth of the renewable energy market, as well as providing for diversification for on-farm income, and more broadly diversification of employment and economic opportunities within the Dubbo Regional Council LGA.

Objective	Project
To minimise the fragmentation and alienation of resource lands	Sheep and cattle grazing activities will continue throughout the life of the Project and will not result in the fragmentation of land currently used for extensive agriculture.
To minimise conflict between land uses within this zone and land uses within adjoining zones	The Project is located on land entirely zoned as RU1, and land adjacent to the Site boundary is also zoned RU1. The Project allows for the continuation of grazing activities, therefore conflicts with the RU1 zones are not anticipated.
To provide for a range of tourism-related uses that support the agricultural industry or are compatible with agricultural uses.	Tourist facilities are not proposed as part of the Project. Refer to Section 8.11 (Socio-Economic Chapter) for discussion on impacts to tourism.

The Project will have an initial life span of approximately 30 years and will not involve permanent changes to the landscape. The size of the Development Corridor (2,770 ha) will not compromise or significantly diminish the availability of land for primary production purposes within the Project Site or surrounding Dubbo Regional Council LGA. Furthermore, due to wind harvesting being a passive land use, the Project will not reduce or permanently impact the inherent soil fertility for agricultural use or compromise the capacity for immediate neighbours to conduct existing or proposed primary production activities.

8.9.3.2 Water Quantity

Construction

Water requirements will be met in accordance with the provisions of the *Water Management Act 2000* (WM Act) by sourcing water from within the locality where practicable. If it is not practicable to source water locally, then it will be brought to the Project Site by external water suppliers under contract to the Project.

It is estimated that in the order of 15 ML of water would be required to produce the quantity of concrete required for gravity foundations, which can be considered the maximum amount of water required for use in concrete batching.

In addition, it is estimated that a further 80 ML of water would be required for road construction and dust suppression activities during construction. This estimated volume would service all new and upgraded on-site internal road construction and dust suppression activities, including those associated with the unsealed public roads. The water volumes provided above are reasonable with regard to the types of activities proposed, however they are estimates and not limits. Prevailing weather conditions during the period of construction, temperature in particular, will affect the volume of water required.

Operation

Surface water use during the operational phase of the Project would be negligible and sourced via suitable and appropriately licenced water sources. Water required for staff amenities shall be sourced from on-site rainwater tanks or delivered to site as potable water. Groundwater will not be used during the operational phase of the Project.

8.9.3.3 Water Quality

Construction

The proposed construction works involve a range of activities that disturb soils and could potentially lead to sediment laden runoff, affecting water quality within local waterways and receiving waters during rainfall and subsequent high flow events. These activities include:

- Excavations for the construction of Internal Roads, ESF and support buildings, construction laydown and parking areas;
- Construction of new watercourse crossings and formalisation of existing temporary / informal watercourse crossings;
- Ground preparations associated with the installation of WTGs;
- Ground preparations for overhead cable installation;
- Trenching for below ground cable installation (including cable crossings in watercourses); and
- Soil compaction and reduced permeability in areas of hardstand and access tracks.

Operation

Operational impacts to water quality are considered low. The extent of construction of access tracks and other impervious surfaces will also influence water quality., especially in the vicinity of gullies and watercourses.

Furthermore, revegetation of riparian corridors is recommended in conjunction with the construction works which would increase vegetated cover across the site and ultimately create a buffer between the wind farm activities and watercourses. The operational use of the Project Site as a wind farm, compared to agricultural uses, would also likely reduce impacts to water quality.

8.9.3.4 Impacts on Adjacent Water Users

As indicated in the sections above, the Project would not impact on the quality or quantity of water available at the Project Site. As such, no impact on water quality or quantity for adjacent water users is anticipated.

8.9.3.5 Hydrology and Flooding

Construction

Installation of roads, pads and other infrastructure for the Project, including adjustment to the terrain to flatten out regions for siting the WTGs has the potential to change hydrology and flood behaviour. The impacts would be changes to stream flow directions, retaining of water before culverts and other flow conveyance structures are installed and creation of concentrated flow paths from runoff from newly formed roads and other hard stand areas.

Operation

To determine the impact of the Project on flooding, indicative access tracks, WTG pads (hardstands), battery compounds and inverters were added to the rain-on-grid model as raised terrain to assess potential changes in flood hydrology.

Under the proposed conditions, proposed infrastructure (such as Internal Roads, WTG hardstands, ESF, compounds and inverters) will create an additional impervious area within the catchment that may change the runoff characteristics of the catchment. Most, if not all, of the imperviousness added by these features are as indirect impervious (i.e. not directly connected to waterways). Applying the infrastructure features, under a worst-case scenario with all infrastructure being fully impervious and directly connected to the waterways, results in a maximum overall change in imperviousness across the full model domain of less than 1% (1.81 km^2 of 210.33 km^2). The majority of this increase in impervious area being on the ridgelines of the terrain, away from the concentrated flow paths. Hence, the impact of impervious area on the resulting flows would be negligible.

The Internal Roads will alter flow paths in the catchment through diverting drainage lines away from their natural direction. Additionally, the roads intersecting streams are likely to cause an impact on hydrology as the roads can be barriers to flow that could block streamflow and cause disconnection of streams. The initial design provided for modelling does not include culverts, bridges, or other hydraulic structures. The inclusion of these hydraulic structures would need to be included in the detailed design stage to address the items above and the aquatic ecology (stream connectivity) considerations.

The inclusion of the WTGs, Internal Roads, hardstands and drainage in the proposed conditions modelling showed that the drains distribute flows away from the roads in the 10% AEP event. An example of this is shown in Figure 8-50. Further details of the model and flooding impacts are presented in Appendix P.

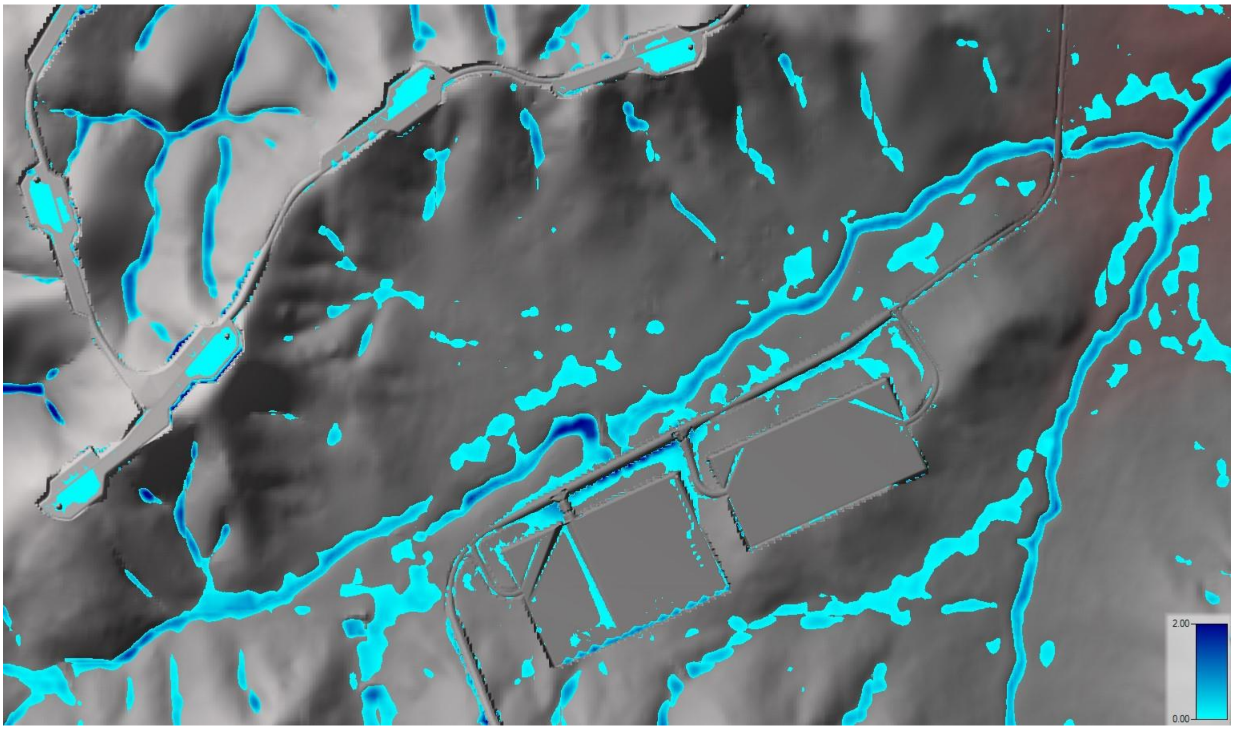


Figure 8-50: Developed conditions 10% AEP flood depths for the same region of the Project Site as shown in Figure 8-40. Depth scale between 0 metres and 2 metres

For the 1% and rarer events, flows exceed road drainage capacities (as expected) and show some impact from the roads and hardstands. During detailed design, roads should be graded such that flows cannot pond around the WTGs, compounds and any electrical infrastructure. The results also show that some of the ESF and storage compounds are located close to watercourses. Modelled flood levels are likely to impact, or be close to impacting, on this infrastructure. If, during detailed design, these areas are located in potentially impacted areas, adjustment should be made to these locations to create a freeboard above the relevant flood depth.

The roads have been modelled without culverts; in the models, water can back up behind these roads. This would not occur to the same degree once appropriate drainage was included. Depending on the location, this may either decrease flood depths (e.g. from water being moved downstream) or increase flood depths (e.g. from water which was held upstream now passing downstream) and would need to be re-modelled during detailed design.

The inclusion of the WTGs, Internal roads, hardstands and drainage in the proposed conditions resulted in higher velocities along the edge of the roads near the drains. An example is shown in Figure 8-51, where higher velocities are seen at the edge of the pad in the lower centre of the figure and along the edge of the road in the upper right of the figure. These higher velocities may not be realistic, however, as the roads have been modelled without batters as the steep slopes require specific geotechnical studies which will be undertaken during detailed design post-Development Consent (standard-grade batters of 1:3 are not suitable in some places due to the relief and topography). At detailed design the finalised earthworks design and the regional DEM would be combined with a smooth transition to correct this.

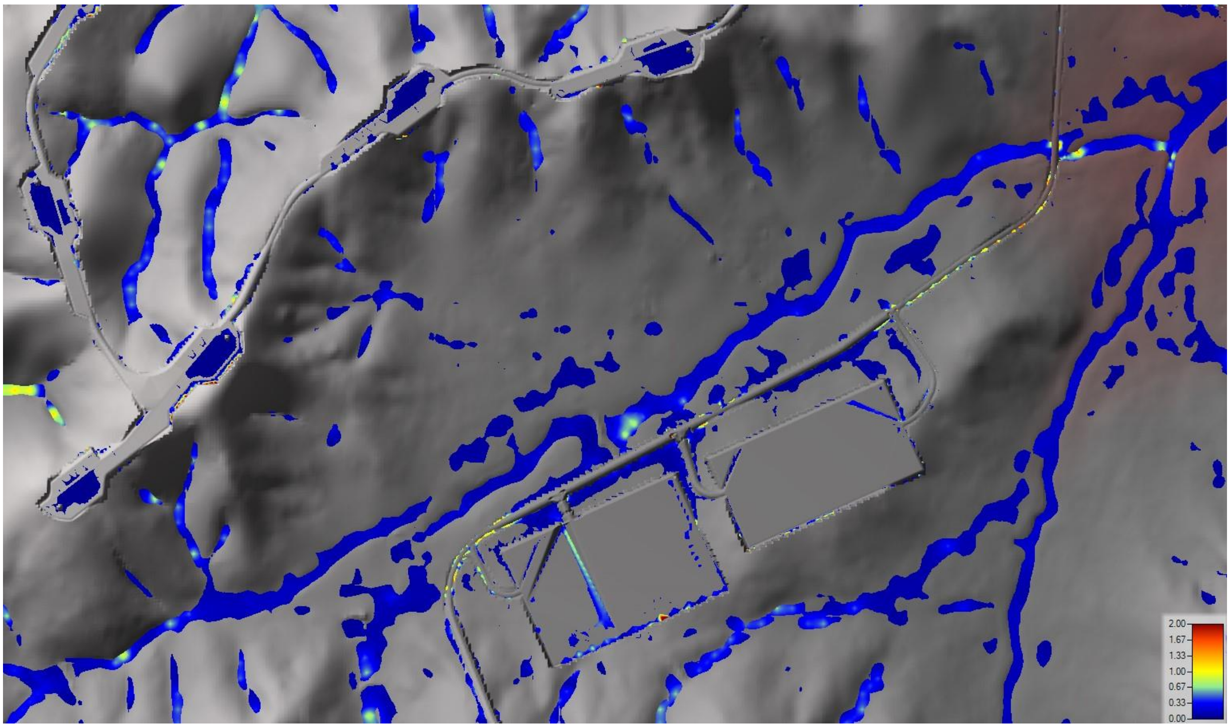


Figure 8-51: Developed conditions 10% AEP velocities for a region of the Project Site. Velocity scale between 0 and 2 m/s

Flow velocities within the watercourses vary such that some areas are below the level that might be expected to require artificial protection (i.e. rock armouring), while others would benefit from protection of stream banks using armouring. Thus, flows range from below (< 2 m/s) to within (4 m/s) tabulated thresholds for armour rock. Given the current conditions of the site, this could be limited to the vicinity of the proposed infrastructure and its local discharge into the receiving environment (e.g. in the immediate vicinity of any culvert outfalls, where flow is concentrated). During detailed design, this should be reviewed to ensure appropriate waterway protection is in place. Further details of the model and flooding impacts are presented in Appendix P.

Hydrology and Flooding Conclusion

Hydrological modelling showed that there is minimal expected sheet flow across most of the site due to the high relief of the terrain concentrating flows in valleys. Within the drainage lines themselves, however, modelling indicates some potential for erosion, and this should be considered as part of detailed design. Aerial photography, however, indicates good ground-cover vegetation and a corresponding lack of erosion under current management practices.

Based on the predicted velocities and flood extents, the proposed infrastructure for the Project is unlikely to significantly affect downstream erosion or sedimentation provided appropriate design considerations (culverts, rock armouring, etc.) are considered at detailed design stage (designed and installed in accordance with Landcom (2004)). Some scour protection may be warranted where concentrated flow paths enter some defined drainage channels.

The likelihood for impacts to downstream receivers is low and may be further reduced through the management of flow velocities using flow detention basins and/or other mitigation structures before the flows leave the roads and hardstands and enter the receiving environment. Effective design and location of such structures during detailed design would ensure that flows would not differ significantly from current conditions.

8.9.3.6 Aquatic Ecosystems

Direct impacts

The construction of the WTGs, Internal Roads and Ancillary Infrastructure have the potential to impact on aquatic ecosystems within the Project Site and downstream, predominantly where these activities cross or are to be constructed within close vicinity to waterways. Access tracks should be designed in accordance with *Policy and guidelines for fish habitat conservation and management* (Fairfull, 2013), *Guidelines for watercourse crossings on waterfront land* (DPI Water, 2012) and *Why do fish need to cross the road? Fish passage requirements for waterway crossings* (Fairfull and Witheridge, 2003). The design of these crossings will be based on the key fish habitat type (Table 8-48) and waterway class (Table 8-49).

Table 8-48: Key fish habitat and associated sensitivity classification scheme (Fairfull, 2013)

Key Fish Habitat Type	Description
Type One (Highly Sensitive Key Fish Habitat)	• *Posidonia australis* (Strapweed) • *Zostera, Heterozostera, Halophilla and Ruppia* species of seagrass beds >5m2 in area • Coastal saltmarsh >5m2 in area • Coral communities • Coastal lakes and lagoons that have a natural opening and closing regime (i.e. are not permanently open or artificially opened or are subject to one off unauthorised openings) • Marine park, an aquatic reserve or intertidal protected area • SEPP 14 coastal wetlands, wetlands recognised under international agreements (e.g. RAMSAR, JAMBA, CAMBA, ROKAMBA wetlands), wetlands listed in the Directory of Important Wetlands of Australia • Freshwater habitats that contain in-stream gravel beds, rocks greater than 500 mm in two dimensions, snags greater than 300 mm in diameter or 3 m in length, or native aquatic plants • Any known or expected protected or threatened species habitat or area of declared 'critical habitat' under the FM Act • Mound springs
Type Two (Moderately Sensitive Key Fish Habitat)	• *Zostera, Heterozostera, Halophilla and Ruppia* species of seagrass beds >5m2 in area • Mangroves • Coastal saltmarsh >5m2 in area • Marine macroalgae such as Ecklonia and Sargassum species • Estuarine and marine rocky reefs • Coastal lakes and lagoons that are permanently open or subject to artificial opening via agreed management arrangements (e.g. managed in line with an entrance management plan) • Aquatic habitat within 100 m of a marine park, an aquatic reserve or intertidal protected area

Key Fish Habitat Type	Description
	• Stable intertidal sand/mud flats, coastal and estuarine sandy beaches with large populations of in-fauna • Freshwater habitats and brackish wetlands, lakes and lagoons other than those defined in TYPE ONE • Weir pools and dams up to full supply level where the weir or dam is across a natural waterway
Type Three (Minimally Sensitive Key Fish Habitat)	• Unstable or unvegetated sand or mud substrate, coastal and estuarine sandy beaches within minimal or no in-fauna • Coastal and freshwater habitats not included in TYPES ONE or TWO • Ephemeral aquatic habitat not supporting native aquatic or wetland vegetation

Table 8-49: Classification of waterways for fish passage (Fairfull, 2013)

Classification	Characteristics of Waterway Class
Class One (Major Key Fish Habitat)	Marine or estuarine waterway or permanently flowing or flooded freshwater waterway (e.g. river or major creek), habitat of a threatened or protected fish species or 'critical habitat'
Class Two (Moderate Key Fish Habitat)	Non-permanently flowing (intermittent) stream, creek or waterway (generally named) with clearly defined bed and banks with semi-permanent to permanent waters in pools or in connected wetland areas. Freshwater aquatic vegetation is present. TYPE ONE and TWO habitats present.
Class Three (Minimal Key Fish Habitat)	Names or unnamed waterway with intermittent flow and sporadic refuge, breeding or feeding areas for aquatic fauna (e.g. fish, yabbies). Semi-permanent pools form within the waterway or adjacent wetlands after a rain event. Otherwise, any minor waterway that interconnects with wetlands or other CLASS ONE-THREE fish habitats
Class Four (Unlikely Key Fish Habitat	Waterway (generally unnamed) with intermittent flow following rain events only, little or no defined drainage channel, little or no flow or free-standing water or pools post rain events (e.g. dry gullies or shallow floodplain depressions with no aquatic flora present.

Indirect impacts

The construction of watercourse crossings has the potential to cause indirect impacts to aquatic ecosystems. Construction of a new crossing over a watercourse would cause shading of the waterway. Although in some areas the waterways may be currently partly shaded by vegetation, additional shading would decrease the amount of light available for growth of instream and riparian vegetation and aquatic fauna. The higher the bridge, the less shading impact would occur.

Where disturbance from construction associated with the watercourse crossings or WTGs and ancillary structures results in bare ground or increased sunlight penetration into riparian areas, there is the potential for invasion of exotic flora species. The movement of construction vehicles in and around the riparian area can also act as a vector for weed propagules. Impacts include introduction of new weeds to the area and extended penetration of weeds into native plant communities. This may result in a loss of biodiversity and habitat value, smothering of native juvenile plants, harbouring of feral animals and alteration of vegetation structure and riparian function.

The Project would not alter the hydrology of surface water resources such that there would be significant changes to the quantity, timing or duration of flows available to riparian, aquatic or ground water dependent ecosystems.

As there would be no significant change in the overall hydrology of the Project Site during the operational period of the Project, operational activities would have negligible indirect impacts on riparian, aquatic and ground water dependent ecosystems.

8.9.3.7 Geology, Soil and Soil Landscapes

Construction

The Project has potential to impact soils, surface water and land resources through erosion and sedimentation incidents. The potential to impact upon soils and surface water quality on the Project Site is greatest during the construction phase. During this period the soils will be subject to disturbance associated with site preparation and infrastructure installation/removal. Construction works for the proposed wind farm include removal of small areas of vegetation and soil during site preparation and excavation for the proposed substation, battery energy storage system, access roads, temporary laydown area and underground cabling. The upper layer of soil would be subject to temporary disturbance which may lead to erosion and potential sedimentation of waterways during periods of rainfall.

It is necessary for detailed geotechnical surveys to be carried out pre-construction to determine the foundation type per WTG (to analyse soil and geological conditions). Pending geotechnical investigation of the ground conditions across the Project Site, slab (gravity) foundations and/or slab plus rock anchor foundations may be constructed for the Project, which will be determined during the detailed design phase following the assessment of the individual WTG locations (description of foundations provided in Section 4.2.1).

The excavation of ground material required for both types of foundations will be approximately 27 m x 27 m (to a depth determined by geotechnical surveys) and would be undertaken by mechanical equipment and may require low-level blasting where firm rock is encountered. Blasting would be undertaken by qualified personnel subject to relevant statutory requirements and approvals, and in accordance with relevant guidelines for blasting in proximity to neighbouring dwellings.

Indicative hardstand dimensions per WTG are 50 m x 40 m; however, is likely to vary dependent on detailed design, topography, construction methods and chosen WTGs. Hardstands will be surfaced with pavement material to required load-bearing specifications, maintained throughout the construction and operational life of the Project and used principally for construction and periodic maintenance of the Project. Surrounding the hardstand is an area of disturbance included in the Development Footprint which is not a hardstand area but will be used for WTG component laydown and crane structure assembly (among other WTG erection and construction related activities) as well as cut and fill.

General construction activities would include earthworks, excavation and trenching, and have the potential to result in soil erosion (including wind erosion from stockpiles), decreased stability and sedimentation due to localised temporary removal of groundcover and the disturbance of the soil profile.

Most of the groundcover will be retained across the Project Site as soil disturbance would be limited to the Development Footprint (with some exceptions described in 'Key Terms' and Section 4). Where groundcover is removed or degraded during construction in the blade laydown areas and areas of trenching for cable installation, it will be progressively rehabilitated throughout the construction period starting immediately after disturbance, thus reducing the area and duration of the water erosion hazard. Consequently, soil disturbance from these localised excavation activities will be relatively small, isolated and temporary.

Where the ground surface is disturbed for the WTG foundations, hardstands, ESF, operation and maintenance building, inverters, access tracks, the temporary construction compound, laydown and parking areas there is greater potential for increased runoff of water and/or soil erosion. Footings, access tracks and hardstand areas that would require compaction and/or foundations would reduce soil permeability, leading to increased run off and potentially concentrated flows, which could result in soil erosion. Soil compaction from equipment will be moderate, due to the small and discrete footprint of the heavy equipment required for WTG installation.

Areas of the Project Site mapped as part of the Mookerawa or Red Hill soil landscape unit is classified as Class 6 land. For this soil landscape unit, the water erosion hazard is very severe (Class 6) (Table 8-40), however it should be noted that the assessment was based on a 'bare earth' scenario and does not account for groundcover and the main driver in this landscape unit within the Project Site is the presence of dispersive subsoils.

The Project will involve moderate disturbance to the subsoil. During excavation, topsoil and subsoil will be stockpiled separately and backfilling will ensure the topsoil and subsoil are reinstated in the correct order, as the topsoil acts as a chemical and physical barrier against water erosion. Backfilling of trenches and rehabilitation of the groundcover will be progressive, thus reducing the area and duration of bare earth exposed to rainfall. The water erosion hazard of these soils will be greatly reduced by installation and monitoring of sediment and erosion controls during the construction period. If there is sodic material excavated from foundation footings and this material is used at the surface or used for earthworks such as fill batters or bunding, it will be highly susceptible to erosion and failure.

The wind erosion hazard for soil landscapes within the Project Site have been classified as low to moderate based on a combination of soil surface texture, wind erosive power and wind exposure (OEH, 2017a). Exposed ridge tops within the Mookerawa soil landscape have the highest wind erosion potential. However, groundcover at the Project Site is high, providing protection of the soil surface, and the mean annual rainfall at the Site (613.2 mm) indicates the land within the Project Site has a slightly greater capacity to maintain surface cover and wet soil, reducing the opportunity for soil detachment and movement from wind blowing across the surface.

Dust particles, which have the potential to cause short term dust accretion on adjoining trees and pastures where mitigation measures are not in place, may be released as a result of a range of activities associated with the Project including:

- Vegetation clearing;
- Earthworks;
- Stockpiles;

- Rock crushing;
- Mobile concrete batching plant operation;
- Loading and unloading of material; and
- Haulage on unsealed roads.

This risk is limited by mitigation measures proposed in Section 9-Environmental Management.

Some waterway crossings are required to be constructed. Implementation of appropriate control measures is required to ensure that potential direct and indirect impacts on these water bodies are managed during, and post construction from runoff erosion.

Operation

The potential for the Project to impact upon soils and surface water quality during the operational phase, after the disturbed areas and construction compound have been rehabilitated, is minimal. It may be considered the potential for impacts to water quality, compared to current agricultural land use practices such as tilling for broad acre cropping, are decreased, thereby reducing likelihood of erosion, sedimentation and riparian disturbance.

Operational impacts to soil would be minimal as day-to-day activities are generally limited to routine maintenance activities and monitoring which would not result in additional soil disturbance and groundcover would be reinstated and maintained across the Development Footprint. However, there is potential for concentrated runoff to occur during significant rainfall events as a consequence of compacted and impervious access tracks and hardstands. This potential for concentrated flows could result in the erosion of the access tracks and hardstands. The potential for wind and water erosion during operation is considered to be to low due to areas of soil disturbance being progressively rehabilitated with ground cover grasses post construction disturbance.

Similar to the impact of pollution from the construction and ongoing use of impervious surfaces, the proposed construction activities can also impact on the velocity of water entering the creeklines where impermeable surfaces are constructed over existing vegetation (e.g. proposed hard stand areas). Impacts may include change to instream flow velocity which can change the aquatic habitat for macroinvertebrates and other small aquatic fauna (e.g. some macroinvertebrates and macrophytes prefer slow water), increased bank erosion from fast discharge resulting in bed and bank erosion, loss of riparian vegetation, loss of edge habitat and sedimentation of downstream environments.

Decommissioning

At the end of the project life, the Project shall be decommissioned, with the objective of continuing to utilise the land capability to its ongoing agricultural capacity.

Potential impacts associated with decommissioning will be generally similar to those for construction as there will be a need for some local excavation, earthworks for surface reshaping, and the operation of heavy equipment. However, it is anticipated that impacts would be less significant than during construction. Reasons for this include:

- There shall be no further substantial vegetation clearing;
- Access tracks and footings for infrastructure will not need to be constructed; and
- The majority of subsurface infrastructure will remain in place.

No long-term impacts to agricultural capacity are anticipated from the Project. Following decommissioning, the Project Site will be returned to near prior condition and use (agricultural activities, minimising long term land use impacts and mitigating impacts to agricultural capacity).

8.9.3.8 Groundwater

A preliminary hydrogeological impact assessment has been undertaken based on information and data derived from available public data records and information acquired during the desktop review.

The Project Site topography consists of undulating valleys and all registered groundwater bores within 5 km of the Project Site are located at lower elevations, within valleys and along creek lines. In contrast, the proposed WTG locations are to be located along the ridgelines. All bores are thus located at a lower elevation than any of the proposed WTG sites and extrapolated water tables beneath the WTG sites would be expected to be significantly deeper than those recorded at existing bores.

The ridges may, however, represent significant recharge zones for local aquifers (and possibly perched).

The design of erosion and sediment controls may be influenced by the presence of water tables near to the surface, whether seasonal or permanent (Landcom, 2004). The available water level data for the broader region suggests that shallow groundwaters may be responsive to rainfall patterns. Long term climate trends should therefore be considered where Project infrastructure crosses any alluvial sediments and in low-lying areas of the Project Site.

Care will be taken during construction of the WTGs to prevent potential contamination of shallow aquifers in the valley alluvium, or potential perched aquifers. The surface water-groundwater connectivity within this LFB Management Unit is defined in the *Water Sharing Plan for the NSW Murray Darling Basin Fractured Rock Groundwater* as being low to moderate with estimated travel time of years to decades between surface water and groundwater. Thus, any potential impacts now may not express a change in underlying groundwaters for many years. Aquifer interference is unlikely in constructing the Project, therefore no impacts are anticipated to GDEs.

8.9.3.9 Potential Contamination of Soil, Surface Water and/or Groundwater

Construction and Decommissioning

Fuels and lubricants will be used on site during construction activities and pose a potential risk of contamination to soils, surface water and groundwater in the event of a spill. These chemicals may alter soil properties and can impact negatively on soil health and consequently plant growth or if absorbed by plants/animals could potentially enter the food chain with adverse impacts. Contaminants in the soil can be mobilised during rainfall events which may potentially spread contamination through the soil profile, or into surface or groundwater potentially impacting aquatic habitats. Management of temporary sewage systems also pose a risk to surface water quality should spills occur. However, as proper spill minimisation and response procedures will be followed, there would be minimal risk of contamination to surface and groundwater.

Operation

The use of fuels, lubricants, herbicides and other chemicals on site during operation for maintenance activities pose a potential contamination risk to soil, surface and groundwater in the event of misuse or a spill event. Management of sewage systems pose a risk to surface water quality should spills occur. The risk of contamination to surface and groundwater would be minimal assuming dedicated refuelling areas 100 m away from watercourses are established, spill kits are readily available on site and timely spill response procedures are followed.

8.10 Resource Requirements and Waste

The Project design evolution process that seeks to minimise the Development Footprint, while maintaining power generation capacity. Resource requirements and waste production has been minimised through the reduction of WTGs from 249 to 97. Where feasible materials will be reused or repurposed to avoid redirection to waste.

8.10.1 Introduction

The consumption of resources, and production and disposal of waste has the potential to have a negative impact upon the environment, and needs to be managed to ensure that:

- Resources are used efficiently;
- Waste production is minimised;
- Reuse of materials is maximised; and
- Contamination of land and water is avoided.

This section summaries the waste management requirements for the Project. It identifies potential waste management risks and how these risks have been and would continue to be managed. It identifies the types of waste that would be generated by the project and measures to manage and minimise these wastes. The SEARs require the Proponent to: -

- *identify, quantify and classify the likely waste stream to be generated during construction and operation, and describe the measures to be implemented to manage, reuse, recycle and safely dispose of this waste*

Legal requirements for the management of wastes are established under the POEO Act and the Protection of the Environment Operations (Waste) Regulation 2005. Unlawful transportation and deposition of waste is an offence under Section 143 of the POEO Act.

The WARR Act includes resource management hierarchy principals to encourage the most efficient use of resources and to reduce environmental harm. The Project's resource management options would therefore be considered against the following order:

- Avoidance of unnecessary resource consumption;
- Resource recovery (including reuse, reprocessing, recycling and energy recovery); and then,
- Disposal.

The Project aims to adopt these principals to encourage the most efficient use of resources and reduce costs and environmental harm in keeping with the principles of ESD.

Mitigation and management measures are provided in Environmental Management (Section 9) as Statement of Commitment RRW001.

8.10.2 Existing Environment

The Site is characterised by agriculture, comprising mostly of grazing activities and some cropping activities. Responsibility for the management of waste generated by these activities currently lies with the landholders. There are several waste recovery and disposal centres nearby including the Whylandra Waste and Recycling Centre and Wellington Waste Transfer Station, each managed by Dubbo Regional Council (Dubbo Regional Council, 2019). Private waste contractors that service the area include Polpure Liquid Waste Specialists, Cleanaway Dubbo Solid Waste Services, Sams Waste Management, Uni-fence skip bins and Matthews Metal Management for scrap metal disposal.

8.10.3 Potential Impacts

8.10.3.1 Resource use

Construction

Resource requirements are typical of a new development site, including the provision of cement, aggregate, sand, asphalt, water and road base material. Cement for foundations will be sourced by the civil construction company selected to construct the Project by the Proponent. Resources would be sourced locally where practicable. Aggregate and sand will also be sourced locally and as close to the Project Site as possible, including reusing material excavated from the foundations and earthworks onsite. The supply of these materials is not currently limited or restricted, and the likely quantities required by the Project are unlikely to place significant pressure on necessary resources. If it is decided to pursue the establishment of a local quarry, then this will be separately assessed and approved under the relevant planning instrument.

Operation

During the operational life of the Project, the resources used would largely be associated with maintenance activities and the use of machinery and vehicles. While this would require the use of non-renewable resources such as hydrocarbon fuels and oils for machinery and vehicles, in the very limited volumes required, the Project is unlikely to place any significant pressure on the availability of these resources. Otherwise, no additional resources are required for the ongoing operation of the Project. Because wind is a source of energy which is non-polluting and renewable, the Project is designed and intended to create power without the use of fossil fuels or other resources as operational fuel.

Decommissioning

The primary resources required to support the decommissioning phase of the Project would be the use of machinery and vehicles associated with the activities of removing the WTGs and Ancillary Infrastructure. While this would require the use of non-renewable resources such as, hydrocarbon fuels to power machinery and vehicles, in the volumes required, decommissioning of the Project is unlikely to place significant pressure on the local supply and demand of these resources. Accordingly, their use during this limited period is considered reasonable in light of benefits of the initial 30 year term of the Project.

Waste

Construction

Waste streams generated during the construction of the Project would be managed using the waste hierarchy approach of avoidance and re-use before consideration of disposal. Waste generated during the construction would mainly be from works associated with site preparation, demolition, construction of accessways and landscaping. Should waste be found to be unsuitable for reuse or recycling, disposal methods would be selected based on the classification of the waste material in accordance with the *Waste Classification Guidelines: Part 1 Classifying Waste* (NSW EPA, 2014). The Waste Classification Guidelines provide direction on the appropriate classification of waste, specifying requirements for management, transportation and disposal of each waste category.

The types and classification of waste streams generated by the Project would vary throughout the construction phase; however, mostly comprises those listed below in Table 8-50 *Anticipated construction waste types.*

Table 8-50: Anticipated construction waste types

Activity	Waste streams produced	Classification	Waste management strategy
Site establishment & enabling works	Green waste from removal of vegetation including trees, shrubs and groundcover that are unable to be mulched and reused within the Project	General Solid Waste (putrescible)	Minimise areas of vegetation to be removed through site design
Operation of construction machinery	Waste from operation and maintenance of construction vehicles and machinery including adhesives, lubricants, waste fuels and oils, engine coolant, batteries, hoses and tyres.	Hazardous waste, Special waste & Liquid waste	Waste oil and filters from operations activities would be stored in recycling bins, collected by an authorised contractor, and disposed off-site at a dedicated recycling facility. Also, batteries to be collected and recycled by a qualified handler.
Earthworks (cut & fill)	Excavated wastes (spoil), such as soil and rock, primarily from tunnelling and cutting including virgin excavated natural material (VENM).	General solid waste (non-putrescible)	Minimise excavation and fill requirements by site design and use existing internal access tracks where possible.
Construction of permanent operational infrastructure (WTGs)	General construction waste such as timber formwork, scrap metal, steel, concrete, plasterboards and packaging material (crates, pallets, cartons, plastics and wrapping materials)	General solid waste (non-putrescible)	All general construction materials that are potentially recyclable should be disassembled to maximise further reuse (if feasible) and recycling. Waste materials should be clearly separated and stored on-site, monitored and maintained by the site's environment/waste manager.
Construction of permanent operational infrastructure (road works and construction of footings)	Surplus construction material and general site reinstatement waste such as fencing, sediment, concrete, steel, formwork and sandbags.	General solid waste (non-putrescible)	Surplus construction materials associated with road surfacing or footings (WTGs & crane hardstand areas) may be transferred to other parts of the Project for use, or stored by the contractor for future use. In the second instance, surplus construction materials may be recycled where possible. Any surplus materials associated

Activity	Waste streams produced	Classification	Waste management strategy
			with establishing foundations (including road works) should avoid being sent to landfill.
Office staff and contractors (temporary)	General wastes from site offices such as putrescibles, paper, cardboard, plastics, glass and printer cartridges	General solid waste (non-putrescible) and General solid waste (putrescible)	All waste and recycling generated by the site offices should be source-separated into the following dedicated bins: • General waste • Organic waste • Paper/cardboard • Recyclable plastics, glass and metals • Batteries • Toner/cartridges The segregation of recyclables from the general waste stream will maximise resource recovery and minimise materials sent to landfill. All bins should be clearly labelled and coloured to reflect the correct stream. All staff should be trained about the internal office waste management system to ensure adequate understanding across all employees.
Construction of the substation and overhead powerlines	Surplus construction material and general site reinstatement waste such as metal cable offcuts, scrap metal, fencing, sediment, concrete, formwork and sandbags	General solid waste (non-putrescible) and General solid waste (putrescible)	Surplus construction materials associated with the substation and overhead powerlines may be transferred to other sites for use, or stored by the contractor for future use. In the second instance, surplus construction materials may be recycled where possible. Surplus materials should avoid being sent to landfill.

Activity	Waste streams produced	Classification	Waste management strategy
Staff amenities (kitchen & bathroom)	Bio wastes from onsite sewerage collection systems within temporary staff facilities	Liquid waste	Sewerage obtained from within temporary staff facilities would be collected and disposed by an appropriately experienced liquid waste contractor. Depending on the arrangements of the nominated waste contractor, sewerage may be disposed at one of Dubbo Regional Councils sewerage treatment facilities

Under the waste definitions in the POEO Act, most of the waste generated during the construction phase would be classified as general solid waste, either putrescible or non-putrescible. Staff facilities such as transportable amenities buildings at the site would also produce sanitary wastes defined as general solid wastes (putrescible) is accordance with the relevant waste definitions under the POEO Act.

Off-site recycling and disposal locations

There are several locations for off-site recycling and disposal of construction waste generated by the Project. Dubbo Regional Council's waste management facilities at Dubbo and Wellington are equipped to accept mixed commercial and industrial waste, including general waste, green waste, recyclables, oil and batteries. Dubbo Regional Council's waste management facilities would be suitable for recycling and disposing of most of the waste generated during the construction phase of the Project (Dubbo Regional Council, 2019).

Specific resource recovery facilities and waste collection contractors would be selected during the detailed design and contract development stages of the Project and documented in the EMP, OEMP, and DMP. Sanitary waste from temporary staff facilities would be held onsite in an appropriate facility and disposed by a suitable liquid waste contractor.

Operational Waste

Waste streams during the operation of the Project would be limited to minor quantities of putrescible waste from staff amenities, redundant equipment, and general waste from maintenance workers. These would be disposed of via Dubbo Regional Council waste & recycling centres as well as suitably equipped waste contractors.

No waste streams would be associated with the generation of electricity using WTGs. Some materials such as fuels and lubricants, redundant equipment and metals may require replacement over the operational life of the Project, however, would be minimal.

In general, the potential impacts associated with waste generation and management during the operational phase would be similar to those for construction, albeit at a much smaller scale. Operational waste, including general litter clean-up, would be managed in accordance with existing operational maintenance requirements. Operational waste streams would be very low given the low maintenance requirements of the Project and its ancillary components.

Decommissioning

At the end of the operational life of the Project, all above ground infrastructure will be dismantled and removed from the Project Site. The Project has an operation life of up to 30 years after which time it is intended to return the site to agriculture. WTG tower bases would be cut back to below ploughing level or topsoil built up over the footing to achieve a similar result and the land will be returned to near prior condition. A compressor and rock crusher may be required to carry out the cutting work of the foundations and footings. Underground cables (inert and stable) at a depth greater than 500 mm would be left in-situ to avoid unnecessary ground disturbance.

Solid wastes will be generated by decommissioning activities (non-putrescibles, putrescibles), although to a lesser degree compared to the construction phase. Solid wastes include packaging, excess building materials, general refuse and other non-putrescible wastes.

Batteries

While the energy storage technology used (i.e. the type of energy storage) is unconfirmed, the most commercially suitable type will be deployed for use in the Project depending on the detailed design and financial modelling process. A range of technologies have been considered, including lithium-ion, lead acid, sodium sulphur, sodium or nickel hydride, electrochemical technology (i.e. flow batteries), cryogenic storage and compressed air.

Lithium-ion batteries are a probable choice for the Project. Depending on how they are used, lithium-ion batteries may have a lifespan of 5 to 10 years for lithium iron-phosphate and 10 to 30 years for lithium manganese oxide (Queensland Government, 2018). Therefore, batteries may require replacement 1 to 6 times during the lifespan of the Project (30 years).

Under the Australian Code for the Transport of Dangerous Goods by Road and Rail (ADG Code), lithium-ion batteries are classified as dangerous goods. Special provisions, including packaging instructions, for lithium-ion batteries transported for disposal or recycling is provided in the ADG Code.

Nine companies in Australia provide a collection and recycling service for used lithium-ion batteries (ABRI, 2020a): TES-Amm, Ecobatt (part of the Ecocycle and Recycal recycling group), Lithium Australia (including Envirostream), GNB Industrial Power, Enirgi Power Storage Recycling, and MRI E-cycle Solutions. King, Boxall & Bhatt, (2018), reported only one company, Envirostream Australia located in Victoria, has facilities for recycling lithium-ion batteries within Australia and that new recyclers are anticipated to commence commercial battery recycling within Australia in the near future if pilot initiatives succeed (e.g. Neometals; King, Boxall & Bhatt, 2018). Ecocycle is currently one of Australia's largest battery recyclers and is in the process of installing a new large-scale battery recycling machine with capacity for large-scale lithium-ion processing at the Ecobatt warehouse in Victoria (to commence operations late April 2020; pers comms Peter Cage). Facilities for recycling lithium-ion batteries also exist in Asia, North America and Europe, however, shipping lines are beginning to restrict shipping of batteries due to the fire risk, reducing export access to overseas solutions (ABRI, 2020b). If spent batteries are to be exported, an export permit under section 40 of the *Hazardous Waste (Regulation of Exports and Imports) Act 1989* will be required. Given the rapid rise in lithium-ion batteries in Australia, additional cost-effective recycling initiatives may be available locally by the time battery replacement or decommissioning occurs. Predictions for strong growth in the consumption of lithium-ion batteries in electricity storage projects over the next 20 years may significantly impact waste streams from 2025 (Randell Environmental Consulting, 2016).

Waste Classification

The classification and description of the potential waste types likely to be generated by each phase of the Project are summarised in Table 8-51 below.

Table 8-51: Potential waste description

Waste Type	Project phase*	Waste Classification#	Details
Hydrocarbons	C, D	Liquid Waste	Used lubricants, etc.
Construction/ structural Waste	C, D	General Solid Waste (non-putrescible)	Waste from construction would include excess concrete, metal, timber, fittings and packaging.
Domestic/ office waste	C, O, D	General Solid Waste (non-putrescible and putrescible)	Waste would consist of everyday items such as paper, aluminium cans, plastics, packaging and other material generated by onsite contractors.
Green Waste	C	General Solid Waste (non-putrescible)	Cleared vegetation.
Liquid waste	C, D	Liquid waste	Oil, paint, lubricants, glue etc.
Sewage	C, O, D	Liquid Waste General Solid Waste (putrescible)	Effluent from ablutions and office buildings.
Chemical/ hydrocarbon containers	C, O, D	General Solid Waste (non-putrescible)	Fuel and lubricant storage. Herbicides and pesticide storage.

Waste Type	Project phase*	Waste Classification#	Details
Dangerous goods	O, D	Hazardous Waste	Lithium-ion cell and batteries

* C – construction; O – operation D – decommissioning

As defined in clause 49 of Schedule 1 of the POEO Act

Managed effectively, in line with the mitigation measures described in the section below, the generation of waste as a result of the Project would not cause any significant adverse impacts and adequate arrangements can be made throughout the various stages of the Project to ensure resource reuse and waste disposal complies with the relevant legislative requirements, including the EPA *Waste Classification Guidelines.*

8.11 Socio-Economic Factors

The Project has been designed to aligned strongly with the principles of ESD, particularly inter-generational equity. In accordance with these principles, the Proponent has integrated social, economic and environmental considerations in developing the Project to minimise potential impacts. These outcomes have been realised over more than nine years of ongoing consultation that has been reflected in the ongoing evolution of the Project Design.

8.11.1 Introduction

The Economic Impact Assessment has been prepared by Ethos Urban Pty Lt d (2020), and has been undertaken in accordance with the requirements of the SEARs, which include: -

The reasons why the development should be approved having regard to:

- *the environmental, economic and social costs and benefits of the development, having regard to the predicted electricity demand in NSW and the National Electricity Market, the Commonwealth's Renewable Energy Target Scheme, and the greenhouse gas saving of the development.*

A full copy of the Economic Impact Assessment is provided in Appendix V. The assessment provides an analysis of the regional economic profile of townships located within the Dubbo Regional Council LGA and two townships located within the neighbouring Mid-western Regional Council LGA, with consideration of the economic impacts of the Proposed Development during both the construction and operational phases.

A desktop literature review of potential impacts of the Project on the mental health and wellbeing of sensitive receivers in proximity to the Project Site has also been undertaken within this section of the EIS, in accordance with the requirements of the SEARs, which include:

- *consider and document any health issues having regard to the latest advice of the National Health and Medical Research Council, and identify potential hazards and risks associated with electric and magnetic fields (EMF) and demonstrate the application of the principles of prudent avoidance.*

Detailed mitigation and management measures are provided in Appendix V, and are summarised in Environmental Management (Section 9) as Statement of Commitment SE001.

8.11.2 Existing Environment

8.11.2.1 General Project Context and Community Perceptions

The Project is located within the Dubbo Regional Council LGA between Wuuluman and Twelve Mile, approximately 14 km east of Wellington and 60 km south-east of Dubbo in the Orana region of NSW.

The town of Wellington is the closest population centre, which provides a range of opportunities for the regional population, such as health care, education and recreational activities. Other towns near the Project include Gulgong and Mudgee approximately 34 km and 32 km to the north east and south east respectively, which are located within the Mid-Western Regional Council LGA.

During consultation activities described in Section 6.4.3, the Project development team received feedback on a variety of issues from the community listed below, which has prompted Project design changes in response which are detailed in Section 2.7.

- Biodiversity Loss;
- Dust;
- Erosion;
- Fire Fighting;
- Landscape and Visual Amenity;
- Noise;
- Road Modifications, Traffic and Transport Management; and
- Water Use.

As discussed within Section 8.2, a Community Survey of Landscape Values was undertaken by Moir Landscape Architecture to assist in identifying key landscape values. There was general support for renewable energy investment in the region however, 77% of those surveyed believed there would be a negative impact on the character of the local landscape. The Visual and Landscape Assessment concluded that mitigation measures such as the planting of screening vegetation will significantly improve the visual integration of the Project.

A small proportion of agricultural land (estimated at up to 10% of the study area) will be used for Permanent Infrastructure such as internal access roads and siting of WTGs. This land has primarily been used for sheep grazing associated with wool and lamb production. Agricultural activities are anticipated to be largely unaffected, and there is potential for the site to be rehabilitated following the decommissioning of the wind farm.

8.11.2.2 Renewable Energy Targets

Federal and State policies are important factors influencing the demand and investment in the renewable energy sector across NSW, as noted below.

Paris Climate Accord

The Paris Accord is a comprehensive international climate agreement to which Australia is a party. The Accord provides a framework for participating nations to set themselves Nationally Determined Contributions (NDCs), beginning in 2020, with review at five-year intervals. The agreement sets out a global consensus to limit temperature increases to below two degrees Celsius when compared to pre-industrial levels; an additional goal is to maintain this increase at less than one and a half degrees Celsius. NDCs do not have any set lower limit but are required to progress over time (beginning with the intended NDC pledged during the Paris conference), and to be 'ambitious'. Australia's current targets are a reduction in emissions by five% from 2000 levels by 2020, and by 26-28% below 2005 levels by 2030. (Department Agriculture, Water and Environment, 2015).

Federal Renewable Energy Target

The RET is an Australian Government scheme designed to reduce emissions of greenhouse gases in the electricity sector and to encourage the additional generation of electricity from sustainable and renewable sources.

The RET works by allowing both large-scale power stations and the owners of small-scale systems to create certificates for every megawatt hour of power they generate. Certificates are then purchased by electricity retailers who sell the electricity to householders and businesses. These electricity retailers also have legal obligations under the RET to surrender certificates to the Clean Energy Regulator, in percentages set by regulation each year. This creates a market which provides financial incentives to both large-scale renewable energy power stations and to the owners of small-scale renewable energy systems.

In June 2015, the Australian Parliament passed the Renewable Energy (Electricity) Amendment Bill 2015. As part of the amendment bill, the large-scale RET was reduced from 41,000 GWh to 33,000 GWh in 2020, with interim and post-2020 targets adjusted accordingly (Clean Energy Regulator, 2016).

NSW Renewable Energy Action Plan 2013

The NSW REAP provides a framework to enable the State to meet the RET target. While the NSW Government does not mandate a specific renewable energy target for the State (unlike Victoria and

Queensland which have 50% renewable energy targets by 2030), it does have an aspirational target of zero net emissions by 2050.

The NSW Renewable Energy Action Plan Implementation Report was published in December 2018, which outlined that all 24 actions had been implemented, cementing the position of renewable energy generation as a means of meeting energy needs in NSW.

8.11.2.3 Electricity Demand in NSW

The AEMO's 2019 *Statement of Opportunities Report* concluded that although population increase within Australia is the main driver of electricity consumption, average operational electricity consumption is decreasing and is forecast to continue to decrease (Figure 8-52). This is thought to be due to increases in energy efficiency and shifting away from energy-intensive industries. However, load factors are also decreasing. This indicates that the difference between average electricity consumption and maximum electricity demand is growing – meaning Australia is experiencing more record high maximum demand days per year. This requires high electricity usage over short-term durations, putting generating plants at capacity and at risk of critical plant outages.

In the long-term, maximum operational demand is forecast to increase by 0.7% in NSW (AEMO, 2019). Therefore, to ensure critical plant outages during periods of peak demand do not increasingly occur, the development of new renewable energy generation across the NEM is required.

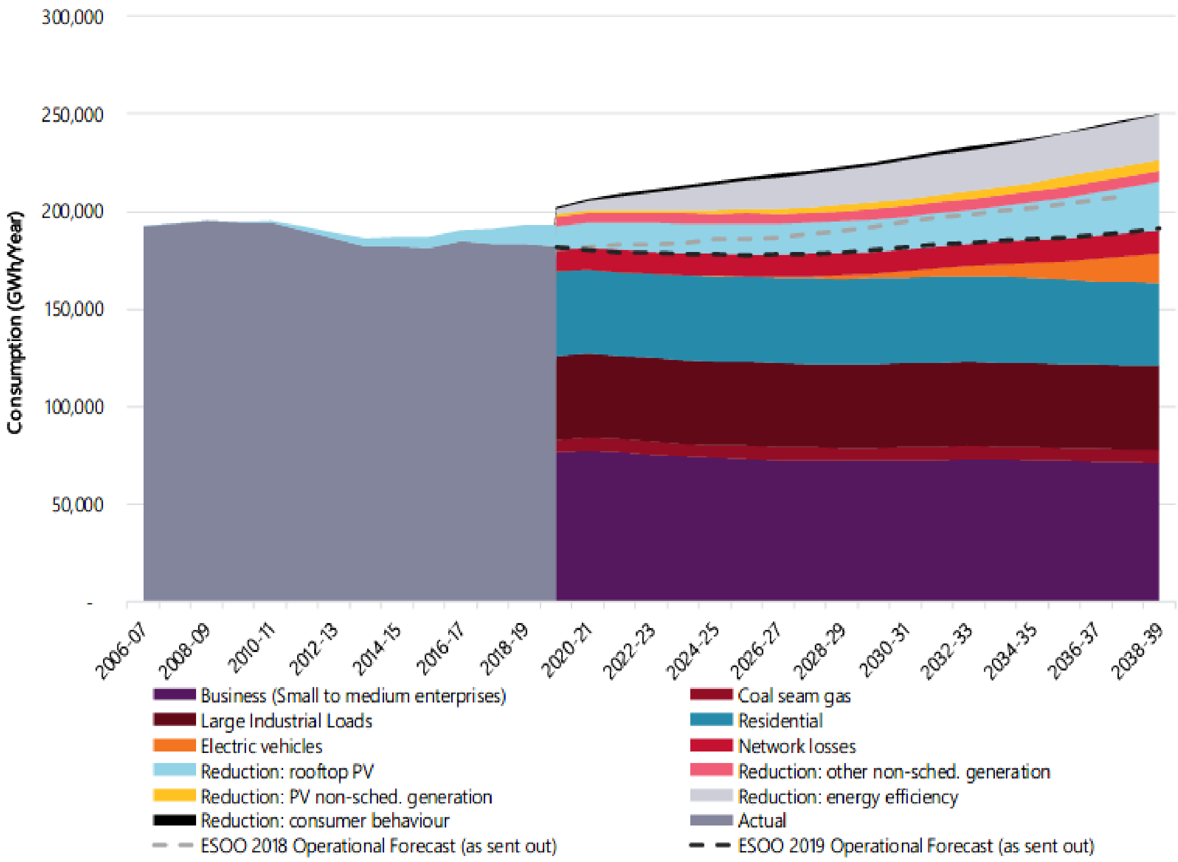


Figure 8-52: Total National Energy Demand consumption (GWh), actual and forecast, 2006-07 to 2038-39 (AEMO, 2019)

As of 18 July 2019, over 7.2 GW of new capacity is committed to enter the market, with the majority being wind and solar generation. Before 2021-22, an additional 4.7 GW of wind and solar energy is expected to reach full commercial use and over 41 GW of proposed wind and solar projects are known to AEMO.

8.11.2.4 Regional Economic Profile

The population of the study area (Dubbo Regional Council) totalled approximately 53,240 persons as of June 2018 (ABS 2019a), 38,390 of which were located within the regional centre of Dubbo. Table 8-52 highlights that over the period of 2018 – 2036, populations levels are expected to expand by 0.4% per annum, or +3,460 persons.

Table 8-52: Population projections for Dubbo and Wellington LGA (from Ethos Urban 2019)

Location	2018[1]	2036[2]	Change 2017-36	Annual Average Growth Rate 2017-36
Wellington	9,460	n/a	n/a	n/a
Dubbo	38,390	n/a	n/a	n/a
Balance	5,390	n/a	n/a	n/a
Study Area	53,240	56,700	+3,460	+0.4%

Source: [1]ABS, 3218.0 Regional Population Growth, Australia (2019a). [2]NSW Department of Environment and Planning (NSW DPIE 2019)

Notes: Figures Rounded

As of March 2019, the Dubbo Regional Council area has a labour force of approximately 28,520 persons, with an unemployment of 2.0%, which is below the state average for New South Wales of 4.5%. This equates to approximately 570 people without employment. Of these, 140 were located within Wellington. This indicates that labour supply within the area is relatively tight. However, there are a reasonable number of job seekers who may benefit from new employment opportunities afforded by the Project (assuming a skills match), particularly in Wellington.

Australian Bureau of Statistics (ABS) Census data for 2016 highlighted the fact that 31.3% of workers within the Dubbo Regional Council LGA were occupied in activities which could generally be applied to those required for the construction of a wind farm. This included 1,880 workers directly employed in the construction sector and a further 890 workers employed in the transport, postal and warehousing sector.

Wellington is the closest township to the proposed wind farm and would provide some support services including temporary accommodation and worker convenience needs. However, most of the project’s servicing requirements would be supported by Dubbo. Dubbo has a larger supply of accommodation options, retail and entertainment services, and medical services, as well as a range of business geared to servicing large civil construction projects. A limited level of project support services could also be sourced from nearby townships including Gulgong and Mudgee, located to the east of the Project Site in the Cudgegong Valley.

8.11.2.5 Community Wellbeing

The association between WTGs and human response is complex, and many factors are responsible for the perceived negative impacts of wind farm projects, particularly regarding the mental health of receptors (whether association or non-associated) and the wider community’s general wellbeing.

Economic benefit, intrusion in privacy and community acceptance of the WTGs and other sources of disturbance are also relevant to perceived levels of annoyance and impact to mental health. Furthermore, personal and contextual aspects can determine a person's level of annoyance due to WTGs. In keeping with the definition of health as 'a state of complete physical, mental, and social well-being and not merely the absence of disease or infirmity' of the WHO, stress as a result of annoyance and sleep disturbance are considered as health effects (Van Kamp & Van den Berg, 2018).

Levels of annoyance, although subjective, can be associated with WTG noise, both when outdoors and indoors. Annoyance is not identified as a disease or health state but is considered relevant to mental health and community wellbeing as it is a universal negative human response to a condition or setting that may result in stress. Stress is a possible moderator or mediator of mental health outcomes. Indirect effects of wind farms on human health through sleep disturbance, reduced sleep quality, quality of life and perhaps annoyance are possible (Van Kamp & Van den Berg, 2018). However, bias and confounding could be possible explanations for the reported associations with indirect health effects, particularly mental health.

Social acceptance of the development of renewable energy sources by the local community is crucial to how the community evaluates and perceives the consequences of the Project. Communication and participation between the Proponent and the community are very important, as are meaningful public consultation processes early in the planning of the Project.

8.11.3 Potential Impacts and Benefits

8.11.3.1 General

The socioeconomic and environmental benefits of developing renewable energy sources, and transitioning to a low carbon future are substantial, providing potential benefits to communities and helping to maintain quality of life in the longer term. Increased adoption of renewable energy sources will assist Australia to transition away from traditional carbon intensive energy production which is linked to atmospheric pollution and carbon emissions associated with climate change. Reducing carbon emissions has the potential to reverse or slow the effects of climate change, benefitting current and future generations (IPCC, 2018).

A positive impact on landowners is anticipated as the estimated 90 km of new Internal Roads will improve connectivity between properties and help with bushfire emergency management within the area. Agricultural activities will be minimally impacted for landowners, however any loss of revenue is anticipated to be offset by WTG lease payments.

8.11.3.2 National Grid Supply Benefits

The Project has the potential to provide sufficient renewable energy to support the annual electricity needs of approximately 170,000 NSW households. This annual calculation is based on: -

> Annual electricity generation of 1,245,000 MWhrs / by average annual NSW electricity consumption per household of 7.3 MWhr = 170,550 households.

In a regional context, the Study Area currently contains 47,630 dwellings (and therefore the Project has the potential to provide the annual electricity needs of the Study Area 3.5 times over, highlighting the importance of the facility from a clean electrical generation perspective.

8.11.3.3 Reduction in Emissions

Once fully operational, the Project will result in the reduction of an estimated 1 million tonnes in carbon dioxide (CO_2) emissions on an annual basis compared to the same level of electricity generation using fossil fuels. This annual calculation is based on: -

> 1,245,000 MWhrs x CO_2 savings per KWhr (0.84 tonnes) = 1,045,800 tonnes per annum

This reduction on CO_2 emissions is the equivalent of taking approximately 373,500 cars off the road annually, based on an average of 14,000 km travelled with CO_2 emissions of 200g/km (or 2.8 tonnes of CO_2 emissions per car per annum).

8.11.3.4 Economic Benefits

The Project would have an overall positive impact on the local and wider economy during both the construction and operational period. In particularly, the Project will have the following economic benefits:

- **Direct and Indirect Employment:** The Project will support 250 direct and 400 indirect FTE positions over the construction period. Once operational, 12 direct and 35 indirect FTE jobs will be supported by the Project. Of these 47 total FTE jobs, it is expected that 19 will be sourced locally within the Dubbo Regional Council area.
- **Industry and Business Participation Opportunities:** The Project will be able to maximise local business participation through contracted work.
- **Local Wage Spending Stimulus:** Non-local construction workers living in the region would be expected to inject approximately $5.6 million in additional spending to the regional economy over the construction phase, supporting approximately 28 FTE jobs in the service sector.

- **Ongoing Economic Stimulus:** The Project will be making approximately $180 million in payments over 30 years to associated landholders.
- **Returns to Council and the Community:** Increases in Council rates caused by the Project, community benefit contributions (discussions ongoing) and community co-investment opportunities which will be subject to market testing post Development Consent.

A number of other major projects, including those associated with renewable energy generation have been approved, and are either in operation or are due for construction in locations which surround the study area. These include: -

- Wellington Solar;
- Dubbo Solar Hub; and
- Bodangora Wind Farm.

Additionally, several more major renewable energy projects are within the planning phase, but have not yet gained approval, including:

- Wellington North;
- Suntop Solar Farm;
- Mumbil Solar Farm; and
- Arthurville Solar Farm.

As such, the Project is likely to provide new opportunities for local workers and contractors who have gained skills and experience on previous solar and wind farm projects. In total, these projects are likely to require over 1,300 workers during their construction phases.

8.11.3.5 Impacts on Health and Wellbeing

Diminished wellbeing due to perceived negative opinions of large-scale wind farms, as well as community division and other social impacts may result in mental health issues and/or exacerbation of pre-existing health conditions of receptors and community members surrounding the Project.

The potential adverse health impacts associated with wind farm developments include mental health impacts (from incidence of noise, shadow flicker, blade glint), increased exposure to EMFs and physical health impacts such as *wind turbine syndrome*, which can lead to degradation in self-perceived health within sensitive receivers.

Research by the NHMRC concludes there is no association between windfarm developments and significant health effects at a distance of more than 1.5 kms from wind farms (NHMRC, 2015). Historically, concern has been expressed by people living near existing wind farms about perceived impacts on their mental health and wellbeing. Evidence suggests proximity to WTGs is associated with varying levels of annoyance, and often associated with sleep disturbance and poorer quality of life. However, it cannot be ruled out that bias or confounding is an explanation for these perceived health effects. The NHMRC has however indicated that further, higher quality research on the perceived impacts of wind farms on mental and physical health should be undertaken.

9 Environmental Management Strategies

9.1 Environmental Management Plans

Environmental management for the Project would be undertaken in accordance with the Project's Environmental Management System, which would be prepared to provide an overall framework for the management of environmental impacts that could potentially arise as a consequence of the Project. Mitigation measures identified throughout this EIS and summarised in Section 9.2 would be incorporated into management plans, which would provide:

- An environmental manual for staff and contractors throughout the construction, operation and decommissioning of the Project;
- Identification of the potential impacts of the Project and the measures identified to mitigate these impacts as described in Section 9.2 of this EIS;
- Details of how environmental mitigation measures are to be implemented;
- Details of the timing of the implementation of the mitigation measures;
- Clearly defined allocations of environmental responsibilities for all staff members and contractors;
- Monitoring and reporting requirements to demonstrate compliance with licensing and approval requirements; and
- Procedures for review and updating of the management plans.

Adherence to the management plans would enable environmental safeguards and mitigation measures to be effectively implemented and sustainable work practices adopted throughout the duration of the Project.

This would demonstrate the Proponent's intent to comply with conditions of consent, relevant environmental legislation, prevent environmental pollution and minimise the impact of the Project on the environment.

9.2 Statement of Commitments

A final design of the Project (Final Layout Plan) would be submitted to DPIE prior to the commencement of construction. Based on the final layout, environmental mitigation measures outlined in this document are to be incorporated into the management plans. Each plan will be prepared prior to each stage of development commencing and submitted to the DPIE for approval. The following mitigation measures have either been identified through the assessment undertaken through this EIS, supporting assessments or are standard best practice environmental management controls. They will be incorporated into the detailed design phase of the Project and during operation of the Project, should it proceed. These mitigation measures will minimise any potential adverse environmental impacts arising from the Project. The mitigation measures are summarised in Table 9-1.

Table 9-1: Statement of commitments

Impact	Objective	Mitigation Measure	Responsibility	Stage* PC	C	OM	RD	Code
Management Plans								
Detailed Design	Minimise Impact	• The project will be designed and constructed with the key objective to reduce environmental impacts. This will include avoiding and minimising impacts where practicable.	Proponent and Construction Contractor	✓				EM001
General	Minimise Impact	• An Environmental Management System (EMS) will be developed which outlines practices and procedures to be followed during construction and operation of the development.	Proponent	✓	✓	✓		EM002
	Minimise Impact	• An Environmental Management Plan (EMP) will be developed by the construction contractor to outline environmental management measures and procedures to be implemented during construction. This will include sub-plans to address: ○ Water quality; ○ Air quality; ○ Heritage; ○ Biodiversity; ○ Noise and vibration; ○ Environmental Incident response and notification; ○ Traffic; ○ Waste; ○ Contamination (including unexpected finds); ○ Storage of chemicals, oils and fuels; ○ High risk activities; and ○ Training and induction.	Construction Contractor	✓				EM003
	Minimise Impact	• All employees and contractors will attend a project induction including details of environmental approvals, site management requirements and an overview of sub-plans contained in the EMP.	Proponent and Construction Contractor		✓	✓		EM004
Landscape and Visual								
Visual Amenity	Minimise Impact	• Visual impact mitigation measures will be offered to owners of non-involved neighbouring residences where there is opportunity to significantly reduce potential visual impacts from the proposal. Visual impact mitigation measures may include landscaping, screen plantings, provision of awnings/blinds, which can be located on the owner's land to minimise visual impacts of the WTG at the residence and its curtilage. Mitigation measures will be determined through consultation with the owner, be reasonable and feasible, and directed towards reducing the visual impacts of WTG on the residences, commensurate with the level of visual impact. • However, this mitigation measure will not apply where the Proponent has an agreement with the relevant owner/s of these residences with regard to visual impact.	Proponent	✓	✓			LV001
	Minimise Impact	• Design and siting of the ESF and Ancillary Infrastructure will be considered to minimise visual impact. This will include for example, retention of existing vegetation and selecting building materials and finishes to reduce reflectivity and be sympathetic to existing landscape.	Proponent	✓	✓			LV002
Impact to Receivers	Minimise Impact	• To minimise impact from external lighting, lighting will be low intensity lighting (except where required for safety or emergency purposes), erected to not shine above the horizontal and comply with Australian Standard AS 4282 (INT) 1997 — Control of Obtrusive Effects of Outdoor Lighting, or its latest version. • If aviation hazard lighting is required, an aviation hazard lighting plan will be prepared in consultation with CASA and installed to comply with CASA's requirements.	Proponent	✓	✓			LV003

Impact	Objective	Mitigation Measure	Responsibility	Stage* PC	C	OM	RD	Code
		Noise and Vibration						

Construction Noise Exceedance	Minimisation	• Construction work will be restricted to the following hours:
		  ○ Monday to Friday – 7 am to 6 pm;
		  ○ Saturday – 8 am to 1 pm; and
		  ○ No construction work on Sundays or public holidays.
		• Notwithstanding works undertaken outside these hours may occur where the activity is inaudible, for emergency works, delivery of certain materials, in accordance with Environmental Planning and Assessment (COVID-19 Development – Construction Work Days) Order 2020 or where agreement from the Secretary has been provided.
			Proponent and Construction Contractor	✓	✓			NV001

	Compliance	• Construction and decommissioning activities will be managed to minimise noise impact in accordance with the Interim Construction Noise Guidelines 2009 and outlined in the EMP. This may include maximising separation distances, use of acoustic barriers, acoustic enclosures, scheduling work and / or modifying work practices.	Proponent and Construction Contractor		✓			NV002
WTG Operational Noise Exceedance	Compliance	• Noise generated by the operation of the WTG will not exceed the relevant noise criteria (refer Figures 8-7 to 8-12) at any non-associated resident. • Where noise generated by the operation of WTG exceeds relevant noise criteria, landowner agreements will be offered to the relevant landowners and / or a noise curtailment regime will be established.	Proponent in consultation with EPA			✓		NV003
		Biodiversity						
Detailed Design	Minimisation	• Micro-siting of WTGs and Ancillary Infrastructure will be undertaken to avoid habitat trees and previously unrecorded threatened flora species.	Proponent	✓				BM001
Biodiversity Impacts during Construction	Minimise Impact	• Prior to the commencement of construction, a BMP will be developed in consultation with BCD. • Pest and feral animal management strategies will be implemented to control vertebrate pest populations within the Project Site and minimise their spread to and from the Project Site. • Weed management strategies will be implemented aiming at preventing and minimising the spread of priority weeds to and from, and within the Project Site. These include controlling any existing priority weed infestations prior to construction activities and implementing weed hygiene protocols. • Pre-clearing surveys will be undertaken by a qualified ecologist to determine if roosts, nests or dens are present in any trees proposed for clearing. • An ecologist/wildlife handler will be present to supervise during clearing of identified fauna roosting or nesting habitat. • Impacts due to bird and bat strike from the Project will be monitored through the implementation of a BBAMP prepared in consultation with BCD.	Proponent and Construction Contractor	✓	✓			BM002
Biodiversity Offsets	Compliance	• A BOS will be prepared prior to commencement of construction to demonstrate the Proponent's capability to provide the required biodiversity offsets in accordance with the NSW Biodiversity Offset Policy for Major Projects. • Following construction contract award and subsequent detailed design of the Project (or stages as appropriate) the actual biodiversity offset liability will be calculated and will be secured within two years from commencement of construction.	Proponent	✓	✓			BM004
		Traffic and Transport						
Traffic and Transport	Minimise Impact	• Prior to the commencement of construction, a TMP will be prepared for the Project in consultation with Transport for NSW and the relevant Councils.	Proponent and Construction Contractor	✓				TM001

Impact	Objective	Mitigation Measure	Responsibility	Stage*				Code
				PC	C	OM	RD	
Impacts during Construction	Minimise Impact	• Prior to transport, the OSOM transport route and Port of entry will be confirmed by the construction contractor. Following which, the TMP will be updated and accompanied with a route survey for approval from the DPIE.	Construction Contractor	✓				TM002
	Minimise Impact	• Road dilapidation surveys will be undertaken in accordance with guidelines and standards established by Austroads of the designated vehicle route prior to construction and decommissioning works and post construction and decommissioning. Following completion of construction and decommissioning works, any development related damage identified in post dilapidation survey will be rehabilitated / repaired.	Construction Contractor	✓				TM003
OSOM Loads	Minimise Impact	• Road infrastructure upgrade works will be undertaken to allow heavy vehicle and OSOM movements along the transport routes, subject to final Port selection and transport route identification. Road upgrades would be undertaken in consultation with relevant road authorities and permits / approvals obtained under the *Roads Act 1993*.	Construction Contractor	✓				TM004
	Minimise Impact	• During peak traffic generation activities and movement of OSOM vehicles, escort vehicles and appropriate traffic management would be adopted to ensure safe passage from the public road network onto the Project Site. Relevant permits under the Heavy Vehicle National Law (NSW) for the use of over-dimensional vehicles will be sought by the construction contractor.	Construction Contractor		✓			TM005
		Hazards / Risk						
Aviation	Minimise	• Prior to the construction of any wind monitoring mast or WTG, details including the coordinates, ground level, height, OLS and proposed hazard lighting of each will be provided to the CASA, Air Services Australia and the RAAF.	Proponent	✓				HR001
Telecommunications	Minimise	• Micrositing of WTG 105 and 106 will be undertaken to minimise adverse impact to the microwave link (7 GHz range) and (UHF link in the 400 MHz range). • If the development causes a disruption to any radio communication services in the area, the disruption to the service will be repaired as soon as possible following the event.	Proponent	✓	✓			HR002
Electromagnetic Fields	Minimise	• Engineering and administrative controls will be used to reduce the potential for EMF emissions in accordance with *Interim guidelines on limits of exposure to 50/60 Hertz electric and magnetic fields* ARPANSA/National Health and Medical Research Council and Overhead Line Design AS/NZS 7000. .	Proponent		✓	✓		HR003
Low Frequency Noise and Infrastructure	Minimise	• To mitigate and negate any perceived health-related impacts from low-frequency noise and infrasound, the following is recommended: o Noise levels to comply with the applicable noise guidelines, unless an agreement is in place with the affected landowners; and o The proposed WTGs are to be constructed with blades upwind of the tower resulting in significantly decreased infrasound noise levels that are well below the level of perception and acceptable noise levels for wind farm developments in rural areas in Australia.	Proponent	✓	✓			HR004
Shadow Flicker and Blade Glint	Minimise	• Shadow flicker associated with WTG will not exceed 30 hours per year at any non-associated resident.	Proponent		✓	✓		HR005
Bushfire and Electrical Fire	Minimise Risk	• A minimum 10 m APZ will be established around each WTG, the compound for the operation and maintenance facilities, the ESF and Substations. The APZs will be established and maintained in accordance with the Rural Fire Services Planning for Bushfire Protection 2019.	Proponent and Construction Contractor	✓	✓	✓		HR006
	Minimise Risk	• In consultation with the RFS, procedures will be developed to manage potential fires on site during construction and operation. This will include high risk tasks, seasonal constraints, fuel load management, mitigation strategies and emergency response procedures.	Proponent and Construction Contractor		✓	✓		HR007
	Minimise Risk	• During construction and operation, the site will be suitably equipped to respond to fires on site. This may include for example a fire fighting trailer, temporary and permanent water storage units, filling points for fire tanker units, emergency information cabinets, etc	Construction Contractor		✓	✓		HR008

Impact	Objective	Mitigation Measure	Responsibility	Stage* PC	C	OM	RD	Code
	Minimise Risk	• Restrictions imposed during declared Total Fire Bans will be observed and consultation carried out with the RFS where required.	Construction Contractor		✓	✓	✓	HR009
	Minimise Risk	• A fire Safety Study (FSS) will be undertaken following the requirements of Hazardous Industry Planning Advisory Paper No.2 – Fire Safety Study Guidelines 2011 to address the risk of external fire impacting on the ESF and a fire initiated in the ESF spreading off the site.	Proponent	✓				HR010
Blade Throw	Minimise Risk	• WTG components will be manufactured and certified to current best practice Australian and international (IEC 61400-23) safety standards and are equipped with sensors that can react to any imbalance in the rotor blades and shut down the WTG if necessary. • WTGs will be subject to stringent safety and security measures including regular maintenance and servicing (within an ISO90001 Quality Assurance system • Contactors certified in the manufacture, delivery, build, inspection, maintenance and repair of WTG components will be employed.	Proponent and Construction Contractor	✓	✓	✓		HR011
		Aboriginal Heritage						
Aboriginal Heritage Items	Avoid	• A CHMP will be prepared in consultation with DPIE and Aboriginal stakeholders. • Where impact cannot be avoided to artefact scatters and PADs within survey units 6, 11 and 24 subsurface testing and surface collection would be undertaken in accordance with *Code of Practice for the Archaeological Investigation of Aboriginal Objects in NSW (DECCW, 2010).* • Additional archaeological assessment will be carried out if any new impacts are to occur outside the Development Corridor. • Design and ground disturbance will be undertaken to minimise impact to heritage items. • If cultural heritage material is located during works that work will cease immediately and a suitably qualified archaeologist engaged to ascertain whether the material is of cultural origins and if so, they will advise how to proceed. • If human remains are found, works should immediately cease, and the NSW Police should be contacted. If the remains are suspected to be Aboriginal, the BCD may be contacted to assist in determining appropriate management.	Proponent and Construction Contractor	✓	✓			AH001
		Historic Heritage						
Historic Heritage Items	Avoid	• Record and assess historical significance of well located within Survey Area 19 before works proceed within a 10 m radius of the well. • If potential historic heritage is identified all work within a 10 m radius of the site will cease and advice sought from an historic archaeologist. If required, notification under Section 146 of the Heritage Act would be undertaken and works would not recommence in the area until permitted.	Proponent and Construction Contractor	✓	✓			HH001
		Water and Soils						
Water Use	Minimise	• Water licences for the development will be obtained in accordance with the *Water Management Act 2000*.	Construction Contractor	✓				WS002
Water Resources (Including Groundwater, Aquatic and Riparian Environments)	Minimise	• A water quality monitoring program will be developed by the construction contractor as part of the water quality management plan. The monitoring program with devise suitable measures to monitor and record on water quality at those watercourses directly impacted from the construction activities. • Where required, VRZs will be established in considerate of the Guidelines for controlled activities on waterfront land Riparian corridors, NSW Department of Industry Guidelines 2018 and Table 8-39. • Watercourse crossings will be designed and constructed in accordance with DPI Water's *Controlled activities on waterfront land – Guidelines for watercourse crossings on waterfront land* (DPI Water, 2012), Why Do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings (2004) and *Controlled Activities: Guidelines for laying pipes and cables in watercourses on waterfront land* (DPI Water, 2012).	Construction Contractor	✓	✓			WS003

Impact	Objective	Mitigation Measure	Responsibility	Stage* PC	Stage* C	Stage* OM	Stage* RD	Code
		• To manage downstream flows and erosion, consideration will be given to appropriate stormwater devises including culverts, rock armouring, scour protection and / or detention basins. Road design and mitigation structures will be appropriately placed during detailed design to ensure that flows will not differ significantly from the current situation. • For each transformer provision will be made in the design for primary and secondary containment of any oil that may leak or spill from the transformers or associated components.						
Geology	Minimise	• Further geotechnical investigation will be undertaken to better understand the constraints of any part of the Development Corridor intersecting with Karst areas identified in the Wellington LEP (mapped as the Cuga Burga Volcanics / Gregra Group).	Proponent	✓	✓			WS004
Erosion	Minimise	• As part of the EMP the contractor will prepare an erosion and sedimentation control sub plan. The plan will be prepared in accordance with the Blue Book *Managing Urban Stormwater: Soils and Construction* (Landcom, 2004) and include: ○ Site constraints and receiving waters; ○ Stockpile management; ○ Temporary site stabilisation and progressive revegetation; ○ Management measures for disturbance of sodic soils; ○ Separation of clean and dirty water; ○ Progressive erosion and sediment controls drawings prepared by a Certified Professional in Erosion and Sediment Control; and ○ An inspection, monitoring and maintenance schedule. • Areas used for temporary construction compound and laydown areas during construction and those areas subject to temporary construction impacts will be restored to original condition and revegetated to achieve the ground cover and erosion minimisation goals.	Proponent and Construction Contractor	✓	✓			WS005
Contamination	Avoid	• Onsite refuelling shall occur in a dedicated area that is located greater than 100m from the nearest drainage line, on an impervious, flat and bunded surface (such as an appropriate drip tray). • Dangerous and hazardous materials will be stored on site in accordance with AS1940-2004: The storage and handling of flammable and combustible liquids. • The concrete batching plants and Substation are suitably bunded. • As the site is located in the catchment area for the Burrendong Dam, fire water containment will be addressed as part of any fire mitigation strategy.	Proponent and Construction Contractor		✓			WS006
		Resource Requirements and Waste						
Resource Requirements and Waste	Minimise and Avoid	• Wastes will be classified in accordance with the NSW EPA Waste Classification Guidelines – Part 1: classifying waste (EPA 2014) and addendum (EPA 2016). • All waste will be handled and stored on site in accordance with its classification and disposed of at appropriately licensed waste facilities. • Provisions as per the ADG Code for the packaging, transportation of spent lithium-ion batteries to collection and/or recycling facilities. An export permit under section 40 of the Hazardous Waste Act will be obtained prior to spent batteries being exported.	Proponent		✓	✓		RRW001
		Socio-Economic Factors						
Socio-Economic Factors	Minimise	• Recruitment of construction staff, contractors and suppliers from the local areas and purchase of local products will be encouraged during all phases of the development. • The Proponent will liaise with local industry and local councils if there is a conflict arising from demand for accommodation and related services.	Proponent	✓	✓	✓		SE001

9.3 Residual Environmental Risk Assessment

A residual environmental risk analysis has been undertaken for all potential environmental impacts that have been considered within this EIS and considers the mitigation measures outlined in Table 9-1. The analysis utilises the risk matrix provided in Table 7-1. The results of this residual risk analysis are provided in Table 9-2.

Table 9-2: Residual environmental Risk analysis of adverse environmental issues

Factor	Receptor	Potential Impact	Likelihood	Consequence	Mitigated Risk
Landscape and Visual	Nearby residences	Reduction in visual amenity	4	A	Medium
	Adjoining landscape	Reduction in visual amenity	4	A	Medium
Noise and Vibration	Nearby residences	Nuisance noise levels during construction	3	A	Low
		Nuisance noise levels during operation	3	A	Low
Biodiversity	Flora species, plant communities and/or habitat	Disturbance/loss	5	A	Medium
	Fauna species	Injury and mortality	2	B	Low
	Terrestrial and aquatic ecosystems	Introduction/spread of weeds	2	A	Low
		Introduction/spread of pests	2	A	Low
		Sedimentation and erosion	2	A	Low
		Soil and water pollution	2	A	Low
		Indirect impacts of proposal e.g. light, noise, dust	2	A	Low
Traffic and Transport	Existing road network	Increase in traffic volumes	3	A	Low
		Increased traffic risks and/or reduced safety	2	B	Low
	Aviation activities	Aviation safety	2	B	Low

Factor	Receptor	Potential Impact	Likelihood	Consequence	Mitigated Risk
Hazards / Risk	Telecommunications distributors	Effects on telecommunications systems	2	B	Low
	Project Site and nearby residences	Health issues relating to electromagnetic fields	2	A	Low
		Health issues relating to low frequency noise and infrasound	2	A	Low
		Health issues relating to shadow flicker and blade glint	2	A	Low
		Use of lithium-ion batteries (ESF)	1	D	Medium
		Bushfire and electrical fire	2	D	Medium
		Blade throw	1	D	Medium
Heritage	Aboriginal heritage	Impacts on known artefacts/values	2	A	Low
		Impacts on unknown artefacts/values	2	A	Low
	Historic heritage	Impacts on known artefacts/values	2	A	Low
		Impacts on unknown artefacts/values	2	A	Low
Water and Soils	Surface water	Degradation of water quality	1	A	Low
	Project Site	Disturbance and erosion of soils and productive topsoil	2	A	Low
		Soil compaction leading to concentrated runoff and erosion	2	A	Low
		Soil contamination due to spills	2	A	Low
		Introduction/spread of weeds	2	A	Low

Factor	Receptor	Potential Impact	Likelihood	Consequence	Mitigated Risk
	Nearby properties	Reduced agricultural viability	2	A	Low
		Dust deposition	2	A	Low
		Reduction in water quantity	1	A	Low
		Flooding	1	A	Low
	Groundwater	Degradation of water quality	1	A	Low
		Reduction in water quantity	1	A	Low
	Aquatic Ecosystems	Direct Impacts	2	A	Low
		Indirect Impacts	2	A	Low
Waste	Project Site and adjoining areas	Contamination of land and water	1	A	Low
		Resource wastage	2	A	Low
		Human and environmental health	2	A	Low
Social and Economic	Social	Safety	2	B	Low
		Health	2	A	Low
		Water Consumption	3	A	Low
	Economic	Decreased Land Value	1	A	Low

10 Conclusion

The Project is located in the Central-West REZ, within the Dubbo Regional Council LGA, 14 km east of Wellington in the Central West of NSW. The Project embraces the principles of ESD, particularly intergeneration equity, in providing a clean and reliable energy source for future generations and aligns with local, state, national and international targets and intentions to move away from fossil fuels in a structured and strategic manner.

The Project would have an electricity generation capacity of approximately 400 MW at the point of connection, producing enough energy to power around 170,550 average NSW households each year. Moreover, the addition of the ESF will allow for the Project to store and dispatch scheduled and reliable energy to and from the Project or the NEM.

The Project is recognised as SSD and is subject to assessment under Division 4.7 of the EP&A Act. This EIS has examined and taken into account all matters affecting or likely to impact the environment by reason of the Project, including consideration of Commonwealth EPBC Act listed MNES.

Information about the Project has been extensively shared with local communities through a variety of consultation approaches. Issues raised during the community consultation process have been addressed through the evolution of the design and are identified throughout this EIS. This principle is strongly reflected in the reduction of WTGs from 330 as initially proposed, to 97 in the current Development Application. As a result of this ongoing process of refinement, the number of residences directly impacted by noise, traffic or visual impacts has significantly decreased from over 100 to fewer than 30.

The Project has been developed and refined within the context of the Avoid-Minimise-Mitigate-Offset hierarchy. Potential environmental impacts associated with the Project have been first avoided, and then reduced during the concept development process. In the absence of mitigation, the Project would result in some impacts on biodiversity via vegetation clearing, soil and water via erosion, noise, visual amenity, dust and traffic via increased vehicle movements.

Mitigation measures, as detailed in this EIS, would ameliorate or minimise these expected impacts to acceptable levels. The Project would also provide a number of employment opportunities and benefits to the local economy, while reducing carbon emissions by displacing up to 1,045,800 tonnes of CO_2 annually (based on current NSW emission figures of 0.87 kg of CO_2-equivilent per kWh) and providing progress towards national and international environmental commitments.

On the basis of the information provided in this EIS, it is concluded that the Project presents relatively minor and manageable environmental impacts, which can be effectively mitigated using best practice strategies and methodologies. Potential benefits associated with the Project are a substantial reduction in greenhouse gas emissions, reduced reliance on non-renewable energy sources and positive outcomes for the local community. On this basis the Project is strongly justified.

11 References

AEMO. (2018). *NEM Electricity Statement of Opportunities*. Retrieved from http://www.aemo.com.au/Electricity/National-Electricity-Market-NEM/Planning-and-forecasting/NEM-Electricity-Statement-of-Opportunities

AEMO. (2018). *NEM Integrated System Plan*. Retrieved from http://www.aemo.com.au/-/media/Files/Electricity/NEM/Planning_and_Forecasting/ISP/2018/Integrated-System-Plan-2018_final.pdf

Australian and New Zealand Environment and Conservation Council (ANZECC). (2000). *Australian and New Zealand Guidelines for Fresh and Marine Water Quality: Volume 1 – The Guidelines.*

Australian Battery Recycling Initiative (ABRI). (2020a). *How to Find A Battery Recycler - Li-ion Batteries.* Retrieved 19 January 2020 from: https://batteryrecycling.org.au/recycle-batteries/why/find-a-recycler/

Australian Battery Recycling Initiative (ABRI). (2020b). *Why is Battery Stewardship Important?.* Retrieved 23 January 2020 from: https://batteryrecycling.org.au/battery-stewardship/why-is-battery-stewardship-important/

Australian Bureau of Agriculture and Resources Economics and Science (ABRES). (2020). *About my region – Far West and Orana region New South Wales.* Department of Agriculture. Retrieved 18 February 2020 from https://www.agriculture.gov.au/abares/research-topics/aboutmyregion/far-west-orana#agricultural-sector

Australian Radiation Protection and Nuclear Safety Agency (ARPANSA). (2015). *Fact Sheet – Electricity and Health.* Retrieved 29 January 2020, from https://www.arpansa.gov.au/sites/g/files/net3086/f/legacy/pubs/factsheets/ElectricityAndHealth.pdf

AusWEA (2002). Best Practice Guidelines for Implementation of Wind Energy Projects in Australia. Australian Wind Energy Association. March 2002.

AusWEA (2004). Fact Sheet 8: Wind Farms & Bird & Bat Impacts. Australian Wind Energy Association.

Bacon, D. (2002). *Fixed-link wind-turbine exclusion zone method*. Radiocommunications Agency UK.

Baerwald E. F., D'Amours, G.H, Klug, B.J. and Barclay, R.M (2008). *Barotrauma is a significant cause of bat fatalities at wind turbines*. Current Biology, Vol 18, R695- R696

Barclay, R.M.R; Baerwald, E.F.; and Gruver, J.C. (2007). *Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height*. Canadian Journal of Zoology 85: 381 – 387, National Research Council Canada.

Brett Lane & Associates (2011). Pr*oposed Rugby Wind Farm Flora and Fauna Assessment Report No. 9193 (23).* Report for Suzlon Energy Australia Pty Ltd.

Bureau of Meteorology (BoM). (2015). *Climate classification of Australia – map of modified Koeppen classification*. Retrieved from http://www.bom.gov.au/climate/averages/climatology/gridded-data-info/metadata/md_koppen_classification.shtml

Bureau of Meteorology (BoM). (2017). *Atlas of Groundwater Dependent Ecosystems*. Retrieved from http://www.bom.gov.au/water/groundwater/gde/map.shtml

Bureau of Meteorology (BoM). (2020a). *Monthly climate statistics for Wellington (065034)*. Retrieved 18 February 2020 from http://www.bom.gov.au/climate/averages/tables/cw_065034_All.shtml

Bureau of Meteorology (BoM). (2020b). *Australian National Groundwater Explorer database*. Retrieved 19 January 2020 from http://www.bom.gov.au/water/groundwater/explorer/map.shtml

Commission for Instruments and Methods of Observation. (2010). *WMO Guidance Paper on Weather Radar/Wind Turbine Siting*. World Meteorological Organisation, Helsinki.

CSIRO and Bureau of Meteorology. (2015). *Climate Change in Australia Information for Australia's Natural Resource Management Regions: Technical Report*. CSIRO and Bureau of Meteorology, Australia

Department of Agriculture, Water and the Environment. (2019). *Climate Solutions Package*. Retrieved from https://www.environment.gov.au/climate-change/climate-solutions-package

Department of Agriculture, Water and the Environment. (2020). *EPBC Act policy statements.* Retrieved from http://www.environment.gov.au/epbc/policy-statements

Department of Environment and Energy (DoEE). (2017). *Climate change Government and international initiatives*. Retrieved from https://www.environment.gov.au/climate-change/government.

Department of Environment and Energy (DoEE). (n.d.). *Climate change impacts in Australia*. Retrieved from https://www.environment.gov.au/climate-change/climate-science-data/climate-science/impacts.

Department of Environment and Energy (DoEE). (2019a). *The Renewable Energy Target (RET) scheme*. Retrieved from http://www.environment.gov.au/climate-change/government/renewable-energy-target-scheme.

Department of the Environment and Energy (DoEE). (2019b). *Protected Matters Search Tool.* Retrieved from https://www.environment.gov.au/epbc/protected-matters-search-tool.

Department of the Environment and Energy. (2018). *Australian Energy Update, August 2018*. Canberra.

Department of the Environment. (2013). *Matters of National Environmental Significance: Significant Impact Guidelines 1.1.* Retrieved from: http://www.environment.gov.au/epbc/publications/significant-impact-guidelines-11-matters-national-environmental-significance.

NSW Department of Planning, Industry and Environment (DPIE). (2019). NSW Electricity Strategy. Retrieved from https://energy.nsw.gov.au/media/1926/download

Dubbo Regional Council. (2019). _Rubbish, Recycling & Sustainability_. Retrieved 16 January 2020 from https://www.dubbo.nsw.gov.au/Households---Residents/rubbish-recycling-sustainability

Durgin, G. (2009). The Practical Behavior of Various Edge-Diffraction Formulas. _IEEE Antennas and Propagation Magazine, 51_(3), 24-35.

EMFs info. (2020). _EMFs.info: Electric and Magnetic Fields and Health_. Retrieved 24 February 2020, from http://www.emfs.info/

Fairfull, S. & Witheridge, G. (2003). _Why do Fish Need to Cross the Road? Fish Passage Requirements for Waterway Crossings_. NSW Department of Primary Industries. Retrieved 26 February 2020 from https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0004/633505/Why-do-fish-need-to-cross-the-road_booklet.pdf

Fairfull, S. (2013). _Fisheries NSW Policy and guidelines for fish habitat conservation and management (2013 update)_. Retrieved 26 February 2020 from http://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/468927/Policy-and-guidelines-for-fish-habitat.pdf

Fitzpatrick, R., Powell, B. & Marvanek, S. (2011). _Atlas of Australian Acid Sulfate Soils v2_. Retrieved 20 February 2020 from https://data.csiro.au/collections/#collection/CIcsiro:6181v2 https://doi.org/10.4225/08/512E79A0BC589

Geoscience Australia. (2017). _Groundwater Dependent Ecosystems._ Retrieved from http://www.ga.gov.au/scientific-topics/water/groundwater/understanding-groundwater-resources/groundwater-dependant-ecosystems.

Geoscience Australia. (2020). _Australian Region and Surface Geology, Interactive Maps_. Geoscience Australia. Retrieved from http://maps.ga.gov.au/interactive-maps/#/theme/minerals/map/geology

Graham, P.W., Hayward, J, Foster, J., Story, O.1 and Havas, L. (2018). _GenCost 2018_. CSIRO, Australia.

Hayward, J.A. and Graham, P.W. (2017). _Electricity generation technology cost projections: 2017-2050_: CSIRO, Australia.

International Commission ono Non-Ionizing Radiation Protection (ICNIRP). (2010). _Guidelines for limiting exposure to Time-varying Electric, Magnetic and Electromagnetic Fields_. Retrieved 17 October 2018, from: http://www.icnirp.org/cms/upload/publications/ICNIRPemfgdl.pdf

Intergovernmental Panel on Climate Change (IPCC). (2018). Global warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty. [V. Masson-Delmotte, P. Zhai, H. O. Pörtner, D. Roberts, J. Skea, P. R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J. B. R. Matthews, Y. Chen, X. Zhou, M. I. Gomis, E. Lonnoy, T. Maycock, M. Tignor, T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland.

IRENA. (2016). Wind Power Technology Brief E07 – March 2016. Retrieved from https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2016/IRENA-ETSAP_Tech_Brief_Wind_Power_E07.pdf

IRENA. (2018). *Renewable power: Climate-safe energy compete on cost alone, (#Renewables4Climate update for COP24)*. International Renewable Energy Agency, Abu Dhabi.

Isbell, R. F. (2016). *The Australian Soil Classification.* National Committee on Soil & Terrain: CSIRO Publish, Collingwood VIC. Retrieved from: www.clw.csiro.au/aclep/asc_re_on_line_V2/soilhome.htm

King S, Boxall NJ, & Bhatt AI. (2018). *Lithium battery recycling in Australia*. Report EP181926, April 2018. CSIRO, Australia.

Landcom. (2004). *Managing Urban Stormwater: Soils and Construction (Blue Book).* New South Wales Government.

Lane, T. and Hicks, J. (2019). *A Guide to Benefit Sharing Options for Renewable Energy Projects*. Clean Energy Council. Melbourne.

Mawhinney, W. and Muschal, M. (2015). *Assessment of Murray-Darling Basin Plan water quality targets in New South Wales; 2007 to 2012*. New South Wales Department of Primary Industries, Water, Sydney.

McCallum, L.C., Whitfield Aslund, M.L., Knopper, L.D. *et al.* (2014). Measuring electromagnetic fields (EMF) around wind turbines in Canada: is there a human health concern? *Environmental Health* **13,** 9.

McKenzie, N., Isbell, R.F., Brown, K. & and Jacquier, D. (1999). *Major soils used for agriculture in Australia*. In Soil analysis: An interpretation Manual. Eds K.I. Peverill, L.A. Sparrow, D.J Rueter CSIRO Publishing, Collingwood VIC.

Mitchell, P. (2002). *Descriptions of NSW (Mitchell) Landscapes: Version 2*. Retrieved from https://www.environment.nsw.gov.au/resources/conservation/landscapesdescriptions.pdf

Morgan E.J., Scott M.M. & Cameron R.G. (2000). *Euchareena 1:100 000 Geological Sheet 8732, 1st edition*. Geological Survey of New South Wales, Sydney & Geoscience Australia, Canberra.

Murphy, B.W. & Lawrie, J.W. (1998). *Soil Landscapes of the Dubbo 1:250,000 Sheet*. NSW Department of Land and Water Conservation, Sydney.

Murray-Darling Basin Authority. (2018). *Wetlands GIS of the Murray-Darling Basin Series 2.0*. Retrieved from https://data.gov.au/dataset/wetlands-gis-of-the-murray-darling-basin-series-2-0

National GreenPower Accreditation Program Status Report Quarter 4: 1 October to 31 December, 2018

NHMRC. (2015). *Information Paper: Evidence on Wind Farms and Human Health*. Canberra: National Health and Medical Research Council.

NRAR. (2018). *Guidelines for controlled activities on waterfront land — Riparian corridors*. Retrieved from https://www.industry.nsw.gov.au/__data/assets/pdf_file/0004/156865/NRAR-Guidelines-for-controlled-activities-on-waterfront-land-Riparian-corridors.pdf

NSW Department of Environment & Climate Change (DECC). (2006). *Assessing Vibration: A Technical Guideline*.

NSW Department of Environment & Climate Change (DECC). (2009). *Interim Construction Noise Guideline*. Department of Environment & Climate Change, Sydney.

NSW Department of Environment, Climate Change & Water (DECCW). (2006a). *Macquarie-Bogan River catchment (NSW), Water Quality Objectives explained*. Retrieved from https://www.environment.nsw.gov.au/ieo/MacquarieBogan/report-03.htm

NSW Department of Environment, Climate Change & Water (DECCW). (2006b). *Macquarie-Bogan River catchment (NSW), River Flow Objectives explained*. Retrieved from https://www.environment.nsw.gov.au/ieo/MacquarieBogan/report-04.htm

NSW Department of Environment, Climate Change & Water (DECCW). (2010a). *Aboriginal Cultural Heritage Consultation Requirements for Proponents 2010*. Department of Environment, Climate Change & Water, Sydney.

NSW Department of Environment, Climate Change & Water (DECCW). (2011). *NSW Road Noise Policy*.

NSW Department of Land and Water Conservation (DLWC). (2000). *Soil and landscape Issues in Environmental Impact Assessment. Technical Report No. 34, 2nd edition.* NSW Department of Land and Water Conservation, Sydney.

NSW Department of Planning and Environment (DPE). (2011). *Planning guidelines for hazardous developments, various working papers*. Retrieved from: http://www.planning.nsw.gov.au/Policy-and-Legislation/Hazards/Industrial-Hazards

NSW Department of Planning and Environment (DPE). (2016). *NSW Wind Energy: Noise Assessment Bulletin*.

NSW Department of Planning and Environment (DPE). (2017). *Central West and Orana Regional Plan 2036.* Retrieved from https://www.planning.nsw.gov.au/-/media/Files/DPE/Plans-and-policies/central-west-and-orana-regional-plan-2017-06.pdf?la=en

NSW Department of Planning, Industry and Environment - Water (DPIE-Water). (2020). *Controlled activities*. Retrieved from https://www.industry.nsw.gov.au/water/licensing-trade/approvals/controlled-activities

NSW Department of Planning, Industry and Environment (DPIE). (2019). *NSW Murray–Darling Basin Fractured Rock Water Resource Plan: GW 11 NSW Murray–Darling Basin Fractured Rock*. Retrieved from https://www.industry.nsw.gov.au/__data/assets/pdf_file/0014/225122/draft-nsw-mdb-fractured-rock-wrp.pdf

NSW Department of Planning, Industry and Environment (DPIE). (2020). *MinView. Second Edition.* Retrieved 17 February 2020 from https://minview.geoscience.nsw.gov.au/#/?l=&lat=146.8611117311174&lon=-35.94511684799068&z=13&bm=bm1

NSW Department of Planning, Industry and Environment. (2020). *Planning Portal, ePlanning Spatial Viewer*. Retrieved 27/02/2020 from https://www.planningportal.nsw.gov.au/spatialviewer/#/find-a-property/address.

NSW Department of Primary Industries (NSW DPI). (n.d.). *Key Fish Habitat: Wellington*. Retrieved from https://www.dpi.nsw.gov.au/fishing/habitat/publications/pubs/key-fish-habitat-maps and from https://www.dpi.nsw.gov.au/__data/assets/pdf_file/0009/634374/Wellington.pdf

NSW Department of Primary Industries Office of Water. (2012). *Water Sharing Plan for the NSW Murray-Darling Basin Fractured Rock Groundwater Sources 2012 – Background document*.

NSW DPI Water. (2012). *Controlled activities on waterfront land – Guidelines for laying pipes and cables in watercourses on waterfront land.* Retrieved 26 February 2020 from https://www.industry.nsw.gov.au/__data/assets/pdf_file/0019/160462/licensing_approvals_controlled_activities_laying_pipes_cables.pdf

NSW DPI Water. (2017). Lachlan and South Western Fractured Rock (GW11) and New England Fractured Rock and Northern Basalts (GW17) Water Resource Plans, Status and Issues Paper. NSW Department of Primary Industries, Sydney. Retrieved from https://www.industry.nsw.gov.au/__data/assets/pdf_file/0011/157349/Lachlan-South-Western-Fractured-Rock-GW-WRP-SIP.pdf

NSW DPIE-Water. (2020). *Macquarie-Bogan Catchment Snapshot*. NSW Department of Primary Industry. Retrieved from https://www.industry.nsw.gov.au/water/basins-catchments/snapshots/macquarie-bogan

NSW Environment Protection Authority (EPA). (2014). *Waste Classification Guidelines. Part 1: Classifying Waste.* EPA, Sydney.

NSW Environment Protection Authority (EPA). (2016). *Addendum to the Waste Classification Guidelines (2014) - Part 1: Classifying Waste*. Retrieved from https://www.epa.nsw.gov.au/your-environment/waste/classifying-waste.

NSW Environment Protection Authority (EPA). (2020). *Contaminated land, record of notices.* Retrieved 20 February 2020 from http://www.epa.nsw.gov.au/prclmapp/searchregister.aspx

NSW Environmental Protection Authority (EPA). (2017). *NSW Industrial Noise Policy*. EPA, Sydney.

NSW National Parks and Wildlife Service (NPWS). (2003). *The Bioregions of New South Wales: their biodiversity, conservation and history.* NSW National Parks and Wildlife Service, Sydney.

NSW Office of Environment & Heritage (OEH). (2010). *Reconnaissance Soil and Land Resources of the Murray Catchment.* NSW Office of Environment and Heritage, Sydney. Retrieved from: https://datasets.seed.nsw.gov.au/dataset/reconnaissance-soil-and-land-resources-of-the-murray-catchment

NSW Office of Environment & Heritage (OEH). (2012). *The land and soil capability assessment scheme – second approximation.* NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment & Heritage (OEH). (2014). *Soil condition and land management in New South Wales: final results from the 2008-09 monitoring, evaluation and reporting program.* NSW Office of Environment and Heritage, Sydney. Retrieved from https://www.environment.nsw.gov.au/research-and-publications/publications-search/soil-condition-and-land-management-in-new-south-wales

NSW Office of Environment & Heritage (OEH). (2015). *Community Attitudes to Renewable Energy in NSW*. Retrieved from https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Energy-savings-and-resource-efficiency/community-attitudes-to-renewable-energy-nsw-150419.pdf

NSW Office of Environment & Heritage (OEH). (2015). *Hydrogeological Landscapes for the Murray Catchment Management Authority – Eastern Murray Catchment.* NSW Office of Environment and Heritage, Sydney. Retrieved from: https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Land-and-soil/eastern-murray-catchment-150240.pdf.

NSW Office of Environment & Heritage (OEH). (2016). *NSW Climate Change Policy Framework.* Retrieved from https://www.environment.nsw.gov.au/-/media/OEH/Corporate-Site/Documents/Climate-change/nsw-climate-change-policy-framework-160618.pdf.

NSW Office of Environment & Heritage (OEH). (2016b). *Hydrogeological Landscapes of New South Wales and the Australian Capital Territory.* NSW Office of Environment and Heritage, Sydney. Retrieved from: https://datasets.seed.nsw.gov.au/dataset/hydrogeological-landscapes-nsw-act.

NSW Office of Environment & Heritage (OEH). (2016c). *NSW – the bioregional landscape.* Retrieved from http://www.environment.nsw.gov.au/bioregions/BioregionsNswoutlineLandscape.htm

NSW Office of Environment & Heritage (OEH). (2017a). *Land and Soil Capability Mapping for NSW*. OEH, Sydney.

NSW Office of Environment & Heritage (OEH). (2017b). *Digital soil maps for key soil properties over New South Wales.* NSW Office of Environment and Heritage, Sydney.

NSW Office of Environment & Heritage (OEH). (2018b). *Salinity.* Retrieved from: https://www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation/salinity/

NSW Office of Environment & Heritage (OEH). (2019). *Types of salinity and their prevention.* Retrieved from: https://www.environment.nsw.gov.au/topics/land-and-soil/soil-degradation/salinity/type-of-salinity-and-their-prevention

NSW Office of Water. (2012). *Guidelines for riparian corridors on waterfront land*. Retrieved from http://www.water.nsw.gov.au/__data/assets/pdf_file/0004/547222/licensing_approvals_controlled_activities_riparian_corridors.pdf

NSW Planning and Environment. (2018). *1:250 000 Geological Maps.* Retrieved from https://resourcesandgeoscience.nsw.gov.au/miners-and-explorers/geoscience-information/products-and-data/maps/geological-maps/1-250-000

NSW Rural Fire Service (RFS). (2006). *Planning for Bushfire Protection: A guide for Councils. Planners, Fire Authorities and Developers.* NSW Rural Fire Service.

NSW Rural Fire Service (RFS). (2019). *Planning for Bushfire Protection: A guide for Councils. Planners, Fire Authorities and Developers.* NSW Rural Fire Service.

NSW Wind Energy Guideline for State Significant Wind Energy Development (2016)

Quarterly Update of the National Greenhouse Gas Inventory: December 2017 Incorporating National Electricity Market Emissions up to March 2018 (the Quarterly Update)

Queensland Government. (2018). _Types of battery energy storage_. Retrieved 19 January 2020 from https://www.qld.gov.au/housing/buying-owning-home/energy-water-home/solar/battery-energy-storage/types-of-battery-energy-storage

Randell Environmental Consulting. (2016). _Waste lithium-ion battery projections - Lithium-ion forums: Recycling, transport and warehousing._ Retrieved 12 December 2018 from https://www.environment.gov.au/system/files/resources/dd827a0f-f9fa-4024-b1e0-5b11c2c43748/files/waste-lithium-battery-projections.pdf.

Rengasamy, P. & Churchman, G.J. (1999). _Cation exchange capacity, exchangeable cations and sodicity_. In Soil analysis: An interpretation Manual. Eds K.I. Peverill, L.A. Sparrow, D.J Rueter CSIRO Publishing, Collingwood VIC.

Ritchie, H. & Roser, M. (2019). _CO_2 and other Greenhouse Gas Emissions_. Retrieved from https://ourworldindata.org/co2-and-other-greenhouse-gas-emissions

Smales, I (2005). _Modelled cumulative impacts on the Swift Parrot of wind farms across the species' range in south-eastern Australia_. In: Biosis Research Pty Ltd (2006) _Wind Farm Collision Risk for Birds. Cumulative risks for threatened and Migratory species_. Prepared for the Australian Government Department of the Environment and Heritage.

Sonus. (2020). _Noise and Vibration Impact Assessment for Uungula Wind Farm_. Prepared for CWP Renewables Pty Ltd.

South Australia Natural Resources. (2015). Measuring salinity fact sheet. Retrieved from https://www.naturalresources.sa.gov.au/samurraydarlingbasin/publications/measuring-salinity

Spaar R and Bruderer b (1996). _Soaring Migration of Steppe Eagles Aquila nipalensis in Southern Israel: Flight behaviour under Various Wind and Thermal Conditions_. Journal of Avian Biology. 27:289-301

Stace, H.C.T. _et al_. (1968). _Handbook of Australian Soils_. Rellim Technical Publications for the Commonwealth Scientific and Industrial Research Organisation and the International Society of Soil Science: Glenside, S.A.

Strahler, A.N. (1952). Hypsometric (area-altitude) analysis of erosional topography. _Geological Society of America Bulletin, **63**_(11): 1117 – 1142.

UNEP. (2018). _The Emissions Gap Report 2018_. United Nations Environment Programme, Nairobi

WaterNSW. (2020). _Real-time data – All Groundwater_. Retrieved from https://realtimedata.waternsw.com.au/

Wellington Council. (2012). _Wellington Local Environmental Plan 2012_. Retrieved from https://www.dubbo.nsw.gov.au/Builders-and-Developers/Planning-Controls--Tools-and-Resources/wellington-local-environmental-plan-2012

Wellington Council. (2013). *Wellington Development Control Plan 2013*. Retrieved from https://www.dubbo.nsw.gov.au/Builders-and-Developers/Planning-Controls--Tools-and-Resources/development-control-plan

Wellington Council. (2012). *Wellington 2025 Community Strategic Plan: Building our Future Together*.

Wood, T., Dundas, G., and Percival, L. (2019). Keep calm and carry on: Managing electricity reliability. Grattan Institute. Retrieved from https://grattan.edu.au/wp-content/uploads/2019/02/914-Keep-calm-and-carry-on.pdf

Wooldridge, A., Nicholson, A., Muller, R., Cook, W., Winkler, M., Jenkins, B., Grant, S., Agar, B and Brennan, N. (2012) *Hydrogeological Landscapes for the Western Central West Catchment – Final Report*, NSW Office of Environment and Heritage, Department of Premier and Cabinet, Wagga Wagga.