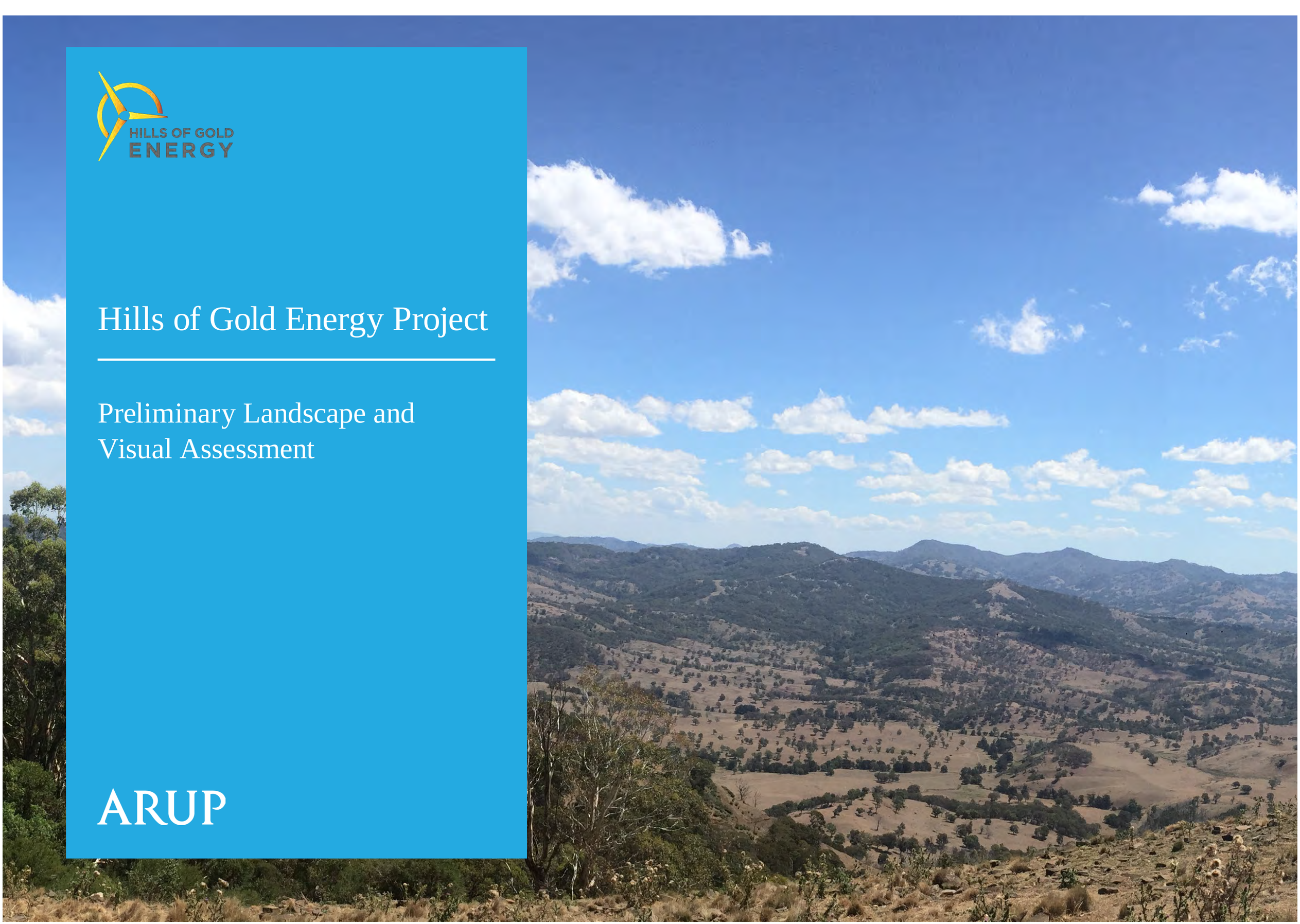
APPENDIX F PRELIMINARY LANDSCAPE AND VISUAL IMPACT ASSESSMENT

Prepared by Arup Pty Ltd

Hills of Gold Energy Project

Preliminary Landscape and Visual Assessment

ARUP



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Content

01
Introduction

Introduction

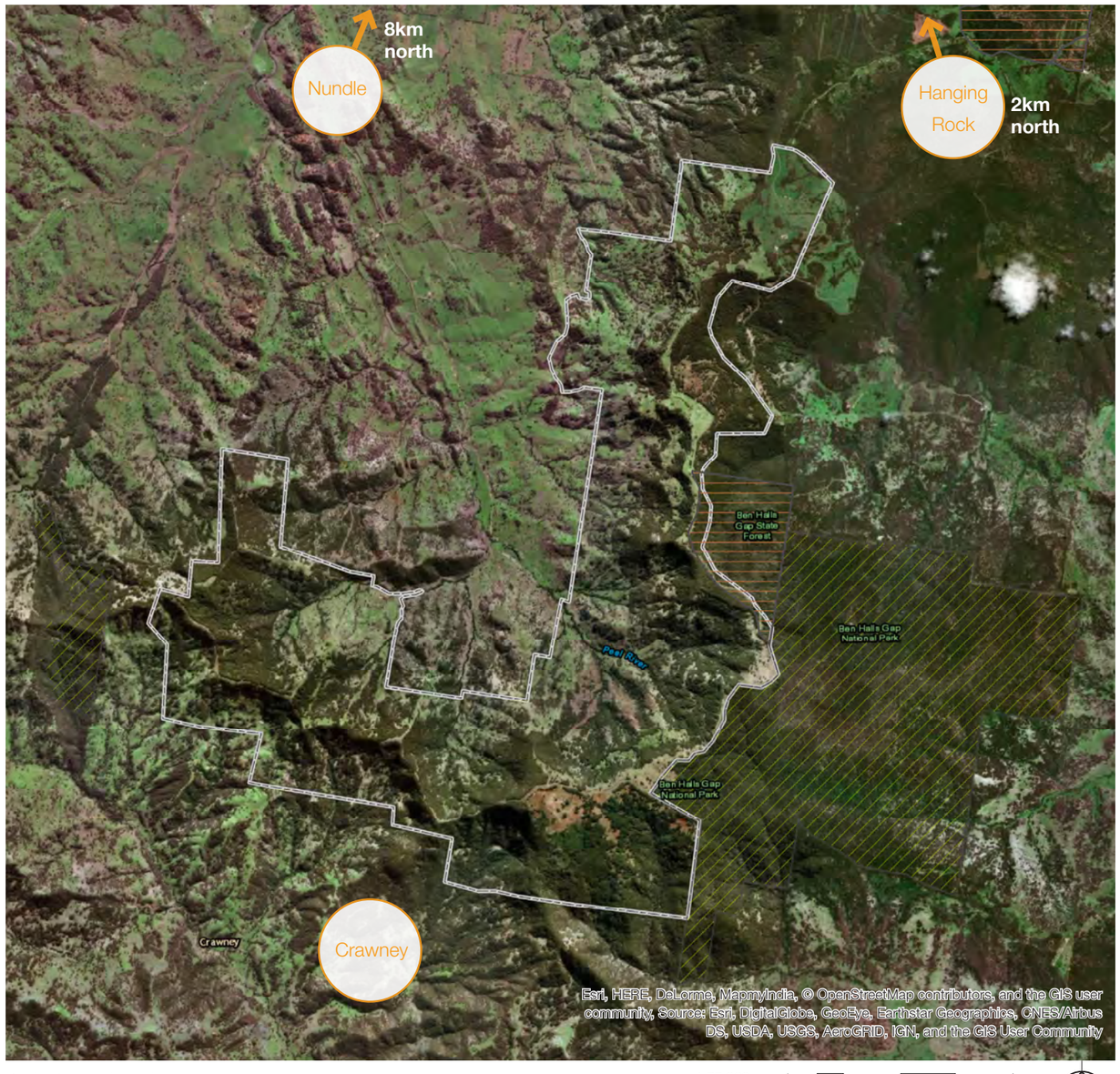
Project Overview

The Hills of Gold Energy project would comprise of the installation of approximately 97 wind turbines that would supply electricity to the national electricity grid. The location of the turbines is subject to ongoing wind measurements, specialist reports and consideration of community consultation.

To reduce the potential of misleading the community and affected landholders, this preliminary assessment presents information informed by a worst-case scenario, with a focus on a wind farm development boundary, rather than determined turbine locations. This 'worst case' approach ensures a comprehensive assessment of the potential extent of landscape and visual influence, which will inform the finalisation of the wind turbine and infrastructure layout.

In accordance with the Visual Impact Assessment Bulletin, Wind Energy (DPE, 2016) (VIA Bulletin), the visual study area has been defined through the preparation of a Visual Envelope Map (VEM). The VEM has been prepared utilising GIS to illustrate the theoretical area from which the Hills of Gold Energy project would be visible in the landscape.

A more precise development area will be informed by detailed site investigations, assessment, wind farm design and community consultation during the Environmental Impact Assessment.



Project overview plan

Purpose of this Report

This report considers the landscape and visual context in which the proposed Hills of Gold Energy project will be located, documents a preliminary understanding of the potential impacts and provides a summary of matters which will require further investigation, assessment, management and mitigation as part of a full Environmental Impact Assessment. Detailed consideration has been given to the extent of potential visual impact to assist the DPE in assessing the proposal and issuing the Secretary's Environmental Assessment Requirements (SEARs)

To inform the Preliminary Landscape and Visual Impact Assessment (PLVA), Hills of Gold Energy has consulted with the community on the preliminary project boundary to gather feedback and an understanding of the key landscape features, areas of scenic quality and key public viewpoints. The community feedback has been reflected in this PLVA.

View from the edge of Ben Halls National Park.

02

Methodology

Methodology

Visual Assessment Bulletin

The VIA Bulletin provides guidance on the assessment of visual impacts that may arise from wind farm projects. The guidance notes that the visual impact will depend upon the characteristics and values of the existing landscape, the extent to which the existing landscape is changed by the project and how these changes will be perceived by individuals and the broader community.

The objectives of the Bulletin are to:

- Provide the community, industry and decision-makers with a framework for visual impact analysis and assessment that is focused on minimising and managing the most significant impacts;
- Facilitate improved wind turbine and ancillary infrastructure siting and design during the pre-lodgement phase of a project, encourage early consideration of visual impacts to minimise conflicts and delays where possible, and provide for a better planning outcome;
- Provide the community and other stakeholders with greater clarity on the process along with an opportunity to integrate community landscape values into the assessment process; and
- Provide greater consistency in assessment by outlining appropriate assessment terminology and methodologies.

Hills of Gold Energy Project Methodology

In line with the direction and objectives of the VIA Bulletin and best practice in landscape and visual impacts assessment, the Hills of Gold Energy project study comprises the following stages

Landscape analysis

- *Landscape baseline analysis* | An analysis of the local context with a focus on landscape features, including topography, land-use, vegetation cover and a review of designated landscapes
- *Landscape Character Assessment* | An analysis of the existing landscape features to divide the landscape in to broad homogeneous units to assist with determining the preliminary impacts that may result from the project.

Visual analysis

- *Visual baseline analysis* | Desktop analysis to ascertain the visual catchment of the development area through the preparation of Visual Envelope Maps (VEM). The VEM analysis has been approached in three ways;

  1. VEM based on the development area boundary, determining the extent of potential visibility from the surrounding landscape
  2. VEM to determine the number of dwelling that have the potential to experience views towards the development area
  3. VEMs from dwelling locations to determine the potential extent of visibility from each dwelling

- *Representative viewpoint selection* An on-site field inspection was undertaken to review the VEM outputs, gain an understanding of the project area in context and gather on-site information. Through the analysis of the VEM and in consultation with the community, representative viewpoints have been identified to illustrate a more complete understanding of the project and potential change that may arise as a result of the project.

Landscape and Visual Assessment

- *Assessment* | A preliminary analysis of the sources of impact and magnitude of change that may arise as a result of the project based on an understanding of the development boundary and provision for wind turbines within the existing landscape and visual context.

The impacts that have been identified are preliminary and would be subject to detailed investigations during the Environmental Impact Assessment stage.

Community

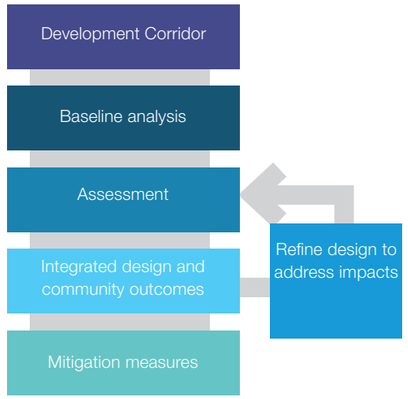
The visual impacts associated with wind farm projects is a common underlying concern of nearby residents and the community. To address this concern, and in accordance with the Bulletin, a community consultation process has been undertaken by Hills of Gold Energy concurrently to establish an understanding of the key landscape features, areas of scenic quality and key public viewpoints valued by the community. These findings have been summarised below.

Key areas of community value include:

- *Sheba Dams are an important tourism destination and historically significant area.*
- *The community seeks a greater understanding of the visual impact of the project based on the likely turbine models, size and layout of the project.*
- *Specific areas of value to the community from which the visual amenity was requested to be assessed included:*
  - *Visual assessment was requested to be assessed from further distances than 3km from the proposed site*
  - *The Hanging Rock lockout and descending the road from Hanging Rock*
  - *From within the town of Nundle (specifically from Jenkins St, Oakenville St, and the cemetery)*
  - *From Hanging Rock*
  - *From residences along Morrisons Gap Road*
  - *From the New England Highway and Lindsays Gap Road near the New England Highway*
  - *From the Golf Course and Bowling Club in Nundle*
  - *Historic homesteads including Woombramurra, Koobah, the DAG Sheepstation and Cottage on the Hill.*
  - *The road over Crawney looking North towards the ridge*

- *Properties along Morrisons Gap Rd*
- *The homestead on Head of the Peel Rd*
- *Homesteads on the other side of the Crawney Pass near Timor.*

- *It was requested that visual photomontages be used to express the visual impact from area of significance*
- *There were misconceptions to the location of the wind farm above Nundle and the visual impact if in that location.*
- *Comments were received that the forestry plantation along the ridge further to the North of the development corridors had already altered the visual amenity of the ridge in parts.*
- *A number of people living with views of the area of the site expressed it be a priority to minimise visual impact*
- *The colour of the turbines should be such that they minimise the visual impact. It was also stated that those hills are often shrouded in clouds, particularly in the morning.*
- *Detail was requested by those living closer to the project on how shadow flicker will be assessed on residents. These areas are considered to be of community value and have informed the PLVA.*



The feedback received from the community on the specific areas of value has informed the selection of representative viewpoints for this assessment. These viewpoints are considered to have an inherently elevated level of sensitivity. The assessment associated with these viewpoints takes a 'worst case' approach to inform the design development stage and the ongoing refinement of turbine locations.

Further community consultation will be undertaken in advance and throughout the Environmental Impact Assessment stage to ensure an optimum design turbine layout is generated.

Assumptions and Limitations

Preliminary assessment

This preliminary assessment of potential landscape and visual impacts has been undertaken on the project design as described within the project overview. Future acknowledgment of additional infrastructure, including the location and design of the hardstand areas, construction compounds, internal access tracks, substations and high voltage overhead powerline, will be subject to detailed investigation and assessment during the Environmental Impact Assessment stage.

This assessment does not seek to define the level of significance or impact at this preliminary stage, but identifies areas of potential impact and magnitude of change and provides a summary of matters which will require further investigation, assessment, management and mitigation as part of the full Environmental Impact Assessment.

Visual perception

Community perception of wind farms is an important consideration in assessing the landscape and visual impact of a project.

This is related to people's perception to renewable energy as well as their reaction to the physical presence of wind turbine infrastructure in the landscape. In the research paper *'Societal acceptance of wind farms: Analysis of four common themes across Australian case studies'* Hall, Ashworth and Devine-Wright (2013), seven case studies were examined which identified strong community support for wind farms generally, but local opposition to specific proposals based on four key themes; trust, distributional justice, procedural justice and place attachment. The findings note *"a 'silent majority' of rural residents who do not explicitly demonstrate support through media attention or political engagement"*. However, they note research indicating the impact of visual changes to a place or landscape can significantly influence attitudes towards a wind farm and highlight the sense of attachment of participants to their local landscape, concluding that "such amenity concerns are highly subjective, difficult to quantify and to compensate if at all".

Wilson and Dyke (2015) in their research *Pre and post-installation community perceptions of wind farm projects: the case of Roskrow Barton,* identified the complexity of determining and addressing community attitudes to wind farms noting that *"the value that individuals attribute to the countryside varies from person to person depending on experience and memories. Judgement is, thus, subjective with some disliking the appearance of wind farms and finding them ugly, whereas others only see graceful structures"*. Their research concluded that (for this example), *"although negative perceptions can be found both pre and post-installation, collectively the community have become used to the turbines and that attitudes have generally become more favourable"*.

To inform the PLVA, Hills of Gold Energy has consulted with the community on the project and the preliminary project boundary to gather feedback and an understanding of the key landscape features and areas of scenic quality, whilst also recording the visual perception of wind farms from individual land owners. At this preliminary stage, the land owner perception is generally positive with comments including, *"wind turbines have a sculptural, elegant form,"* and *"they are a positive step for the community in moving towards renewable energy."* Concerns amongst the community have also been noted particularly with regards to potential impacts on land value.

The research and reaction of the local community to the project highlights that wind farms evoke a subjective response with a range of concerns and opinions.

03

Baseline analysis

An analysis of the local context to determine key areas of sensitivity, landscape character areas and a summary of visual baseline conditions.

Landscape baseline

Local towns

The project is located approximately 8km south east of the town of Nundle within the Tamworth Regional Council Local Government Area (LGA). The three towns within the project area include Nundle, Hanging Rock and Crawney with Barry, Timor, Pages Creek and Garoo situated towards the outer extent.

Nundle

Nundle was established at the foothills of the Great Dividing Range when gold was discovered at Hanging Rock and nearby Swamp Creek in 1952. The population of Nundle grew to approximately 500 in 1865 in response, increasing to approximately 1350 by 1969.

With the decline of the gold mine industry, sheep, cattle and timber are now the primary land uses. A number of historic buildings, including the Nundle Woollen Mill, Old Court House, Peel Inn and Primitive Methodist Church are present in the town and add to the rural historic character of the village, contributing to the town forming a popular tourist destination. With traces of gold and a variety of gemstones found in the area, many tourists also visit Nundle to pan in the Peel River or fossick at Hanging Rock. Other tourist destinations include trout fishing spots in the numerous streams around Nundle and Dag Sheep Station, a venue for weddings, conference and retreats within Nundle.

Hanging Rock

Hanging Rock is situated approximately 10km south east of Nundle, within Tamworth Regional Council.

Similar to Nundle, gold attracted business and people to the town, with a population of approximately several thousand at its peak. Today the primary industry is agriculture and tourism, with people drawn to the area for fossicking. Other attractions include Hanging Rock Lookout, offering a scenic vantage point with views of the Nundle valley.

Crawney

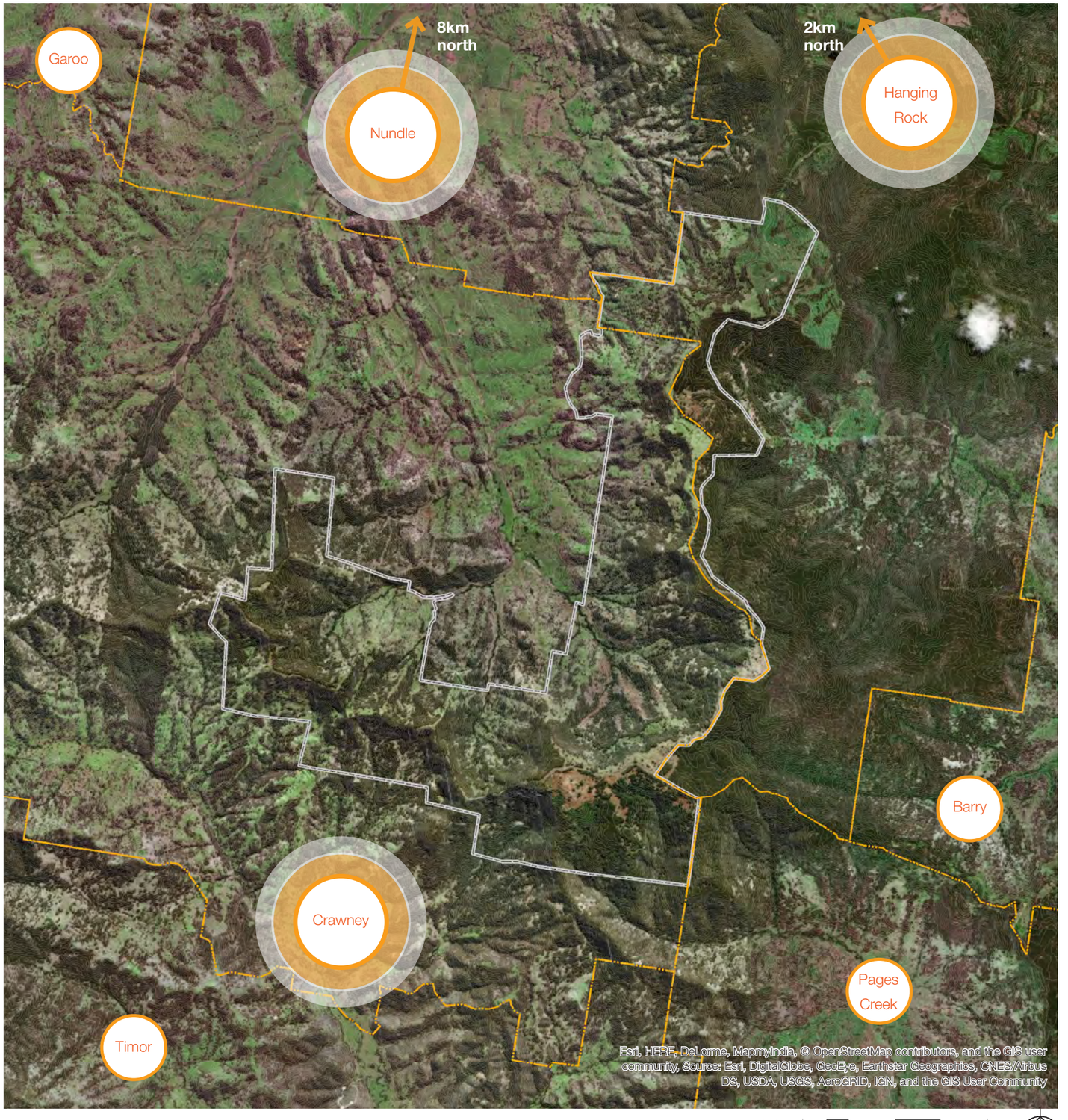
Crawney is situated to the south of the project, approximately 30km to the south of Nundle on the west facing undulating foothill. It consists of a limited number of farmstead properties located on Timor Crawney Road.

View from Hanging Rock Lookout

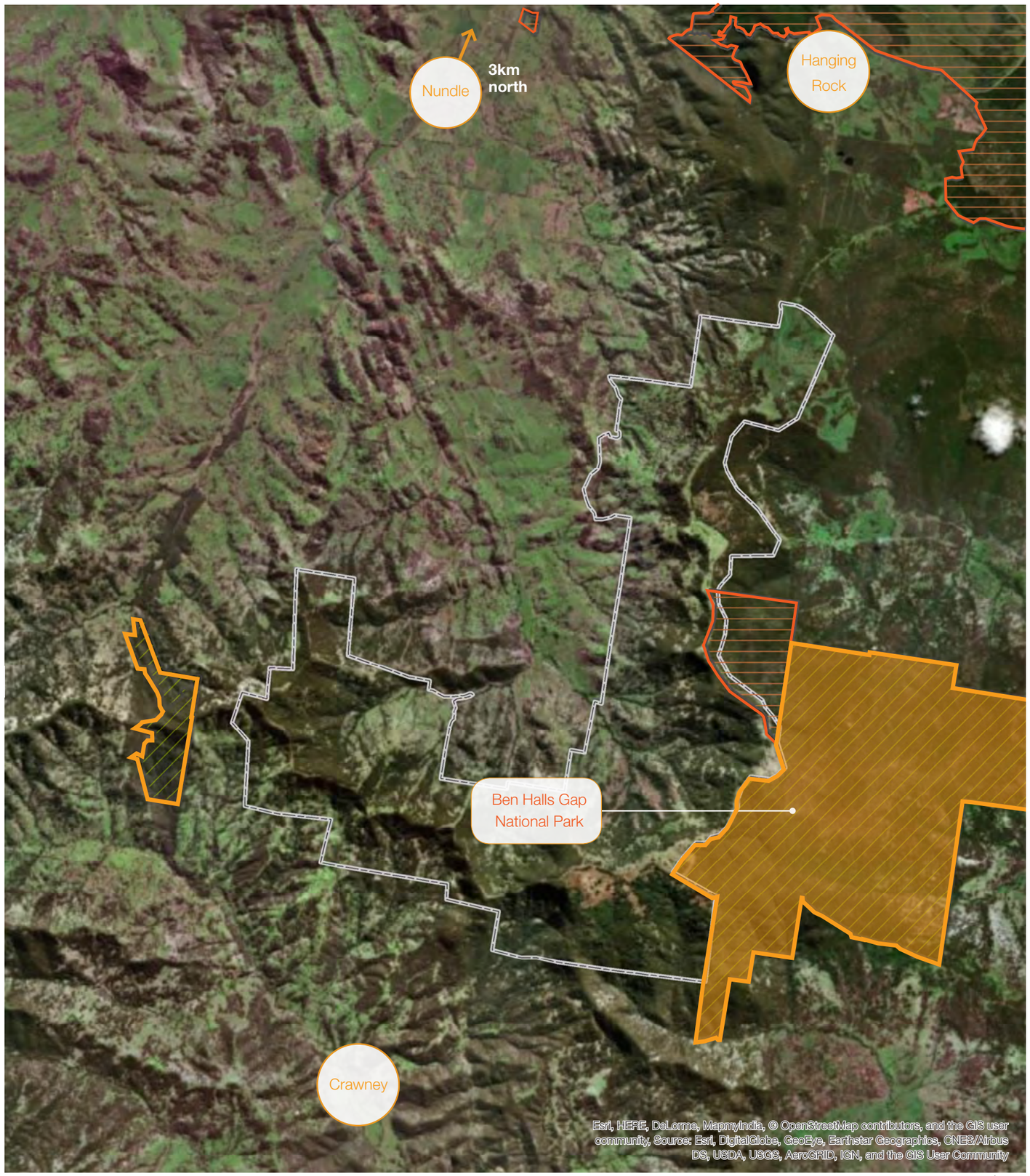
Nundle Woollen Mill

Nundle Peel Inn Hotel

View from Crawney along Timor Crawney Road towards the rolling foothills



Local towns.



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Environmental Value

Ben Halls Gap National Park

Ben Halls Gap National Park is situated to the east of the project area, approximately 10km to the south east of Nundle. The National Park, which covers 2500ha, is located at the junction of the Liverpool and Mount Royal Ranges in the northern tablelands of New South Wales. There are no public roads which provide access to the park and the park contains no visitor facilities.

The park features tall, old growth eucalypt forest. Very little logging and grazing have occurred in the park and as a result it has high quality habitat.

LEGEND:

- Ben Halls Gap National Park
- Other National Parks
- State Forest
- Project boundary

The following general objectives relate to the management of national parks in New South Wales:

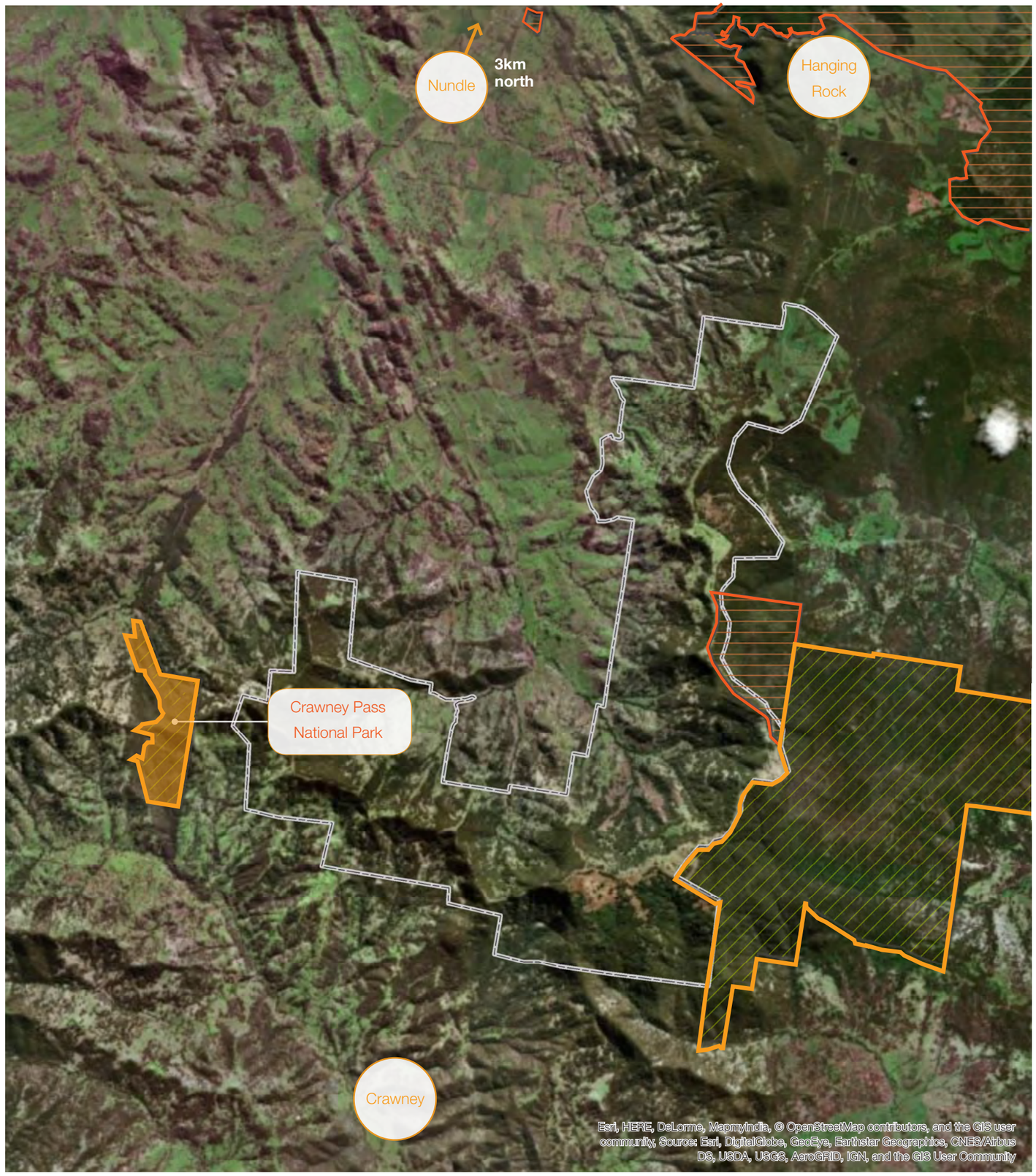
- Protection and preservation of scenic and natural features, including significant geological and geomorphological features;
- Conservation of wildlife, including maintenance of biodiversity and populations of threatened species;
- Maintenance of natural processes;
- Preservation of catchment values and Aboriginal sites in consultation with the Aboriginal community;
- Conservation of non-Aboriginal historic features;
- Provision of appropriate recreation opportunities; and
- Encouragement of scientific and educational enquiry into environmental features and processes, cultural features and use patterns.

In addition to the general objectives, the management of Ben Halls Gap National Park is subject to the following more specific objectives:

- Conservation of Ben Halls Gap National Park as a sample of largely undisturbed old growth tall montane forest;
- Conservation of habitat and populations of the threatened powerful owl, tiger quoll, koala, great pipistrelle and olive whistler and of native mammals and birds dependent upon tree hollows;
- Protection of areas of cool temperate rainforest, threatened plant species and the Sphagnum Moss Cool Temperate Rainforest Endangered Ecological Community;
- Promotion of community appreciation of the value of the undisturbed nature of the park's vegetation communities and its importance for conservation of threatened species and native animals dependent upon old growth forest; and
- Provision of visitor opportunities which encourage appreciation of the natural environment and do not damage the special values of the park.

The primary management priority for the park will be protection of the undisturbed old growth forests by:

- Restriction as far as possible of the incidence and extent of wildfire;
- Monitoring and treatment if necessary to ensure that the park remains largely weed-free;
- Control of introduced animal species, particularly pigs, to reduce populations to levels as low as feasible;
- Specific measures such as survey and monitoring for threatened species and communities;
- Maintenance of good working relationships with neighbours particularly with regard to cooperative pest control, fire management, boundary fencing and access; and
- Restriction of public access to a limited number of organised tours to prevent weed introduction, fire escape, erosion and other damage.



Crawney Pass National Park

Crawney Pass National Park is located on the Liverpool Range and encompasses 249ha. The area is significant due to its natural and cultural values, including nine threatened native animal species and three plants of conservation significance. Of particular significance is the population of Booroolong frog which has experienced massive population decline and is now highly restricted within New South Wales.

The park encompasses an area of steep topography and terraced landscape with steep inclines of more than 30 degrees in places. The elevated location provides scenic value typical of the Liverpool Range with distant views to the north and east, although frequently filtered by vegetation.

Management purpose and principles

Community Conservation Areas

Community conservation areas are established under the Brigalow and Nandewar Community Conservation Area Act. This Act provides for four dedicated management zones of which zones 1, 2 and 3 relate to land reserved under the National Parks and Wildlife Act as a national park, Aboriginal area or a state conservation area, respectively. Land in zones 1, 2 and 3 are managed consistent with the management principles set out in the National Parks and Wildlife Act.

Zone 1 community conservation areas are reserved as a national park under the National Parks and Wildlife Act to protect and conserve areas containing outstanding or representative ecosystems, natural or cultural features or landscapes or phenomena that provide opportunities for public appreciation and inspiration and sustainable visitor use.

Under section 30E of the National Parks and Wildlife Act, zone 1 community conservation areas are managed to:

- Conserve biodiversity, maintain ecosystem functions, protect geological and geomorphological features and natural phenomena and maintain natural landscapes
- Conserve places, objects, features and landscapes of cultural value
- Protect the ecological integrity of one or more ecosystems for present and future generations
- Promote public appreciation and understanding of the park's natural and cultural values

LEGEND:

- Crawney Pass National Park
- Other National Parks
- State Forest
- Project boundary

- Provide for sustainable visitor use and enjoyment that is compatible with conservation of natural and cultural values
- Provide for sustainable use (including adaptive re-use) of any buildings or structures or modified natural areas having regard to conservation of natural and cultural values
- Provide for appropriate research and monitoring.

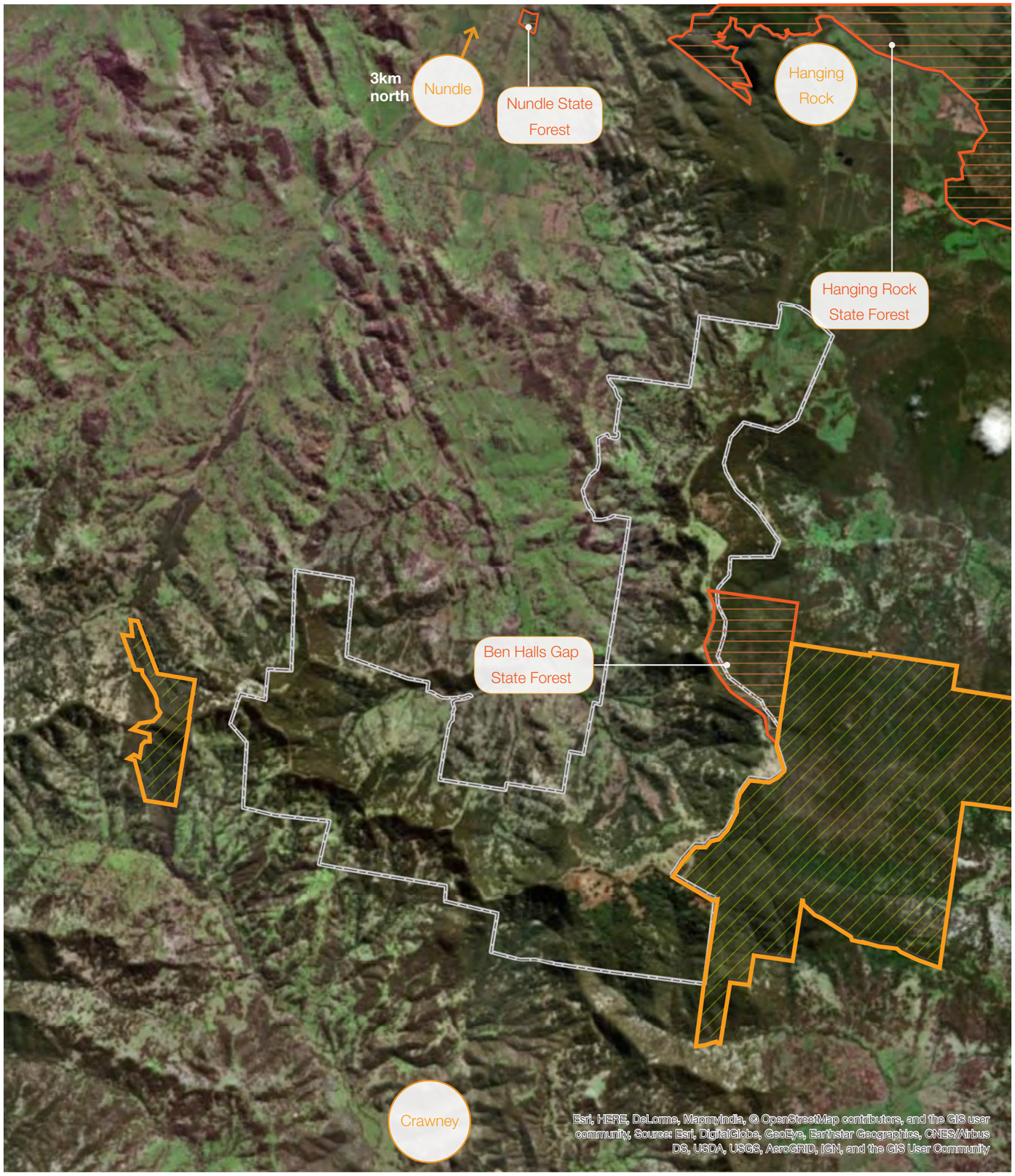
Zone 1 national parks

The primary purpose of zone 1 community conservation areas is to conserve nature and cultural heritage. In doing so, opportunities are provided for appropriate and sustainable recreation. As required by the Community Conservation Area Agreement, the Central West Community Conservation Area Advisory Committee has been involved in development of this plan of management.

Part 11 lands (i.e. unreserved lands) are lands vested in the Minister and include land that is intended to be reserved (e.g. newly acquired additions to the park estate that have not yet been formally reserved); and land that is unlikely to ever be reserved (e.g. severely modified areas, quarries, telecommunication towers, some access roads).

Part 11 lands are managed in accordance with the objectives of the NPW Act, including to:

- Conserve nature, including habitats, ecosystems, biodiversity, landforms, landscapes, wilderness and wild rivers
- Conserve objects, places or features of cultural value
- Foster public appreciation, understanding and enjoyment of natural and cultural heritage and conservation
- Apply the principles of ecologically sustainable development.



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Nundle State Forest and Hanging Rock State Forest

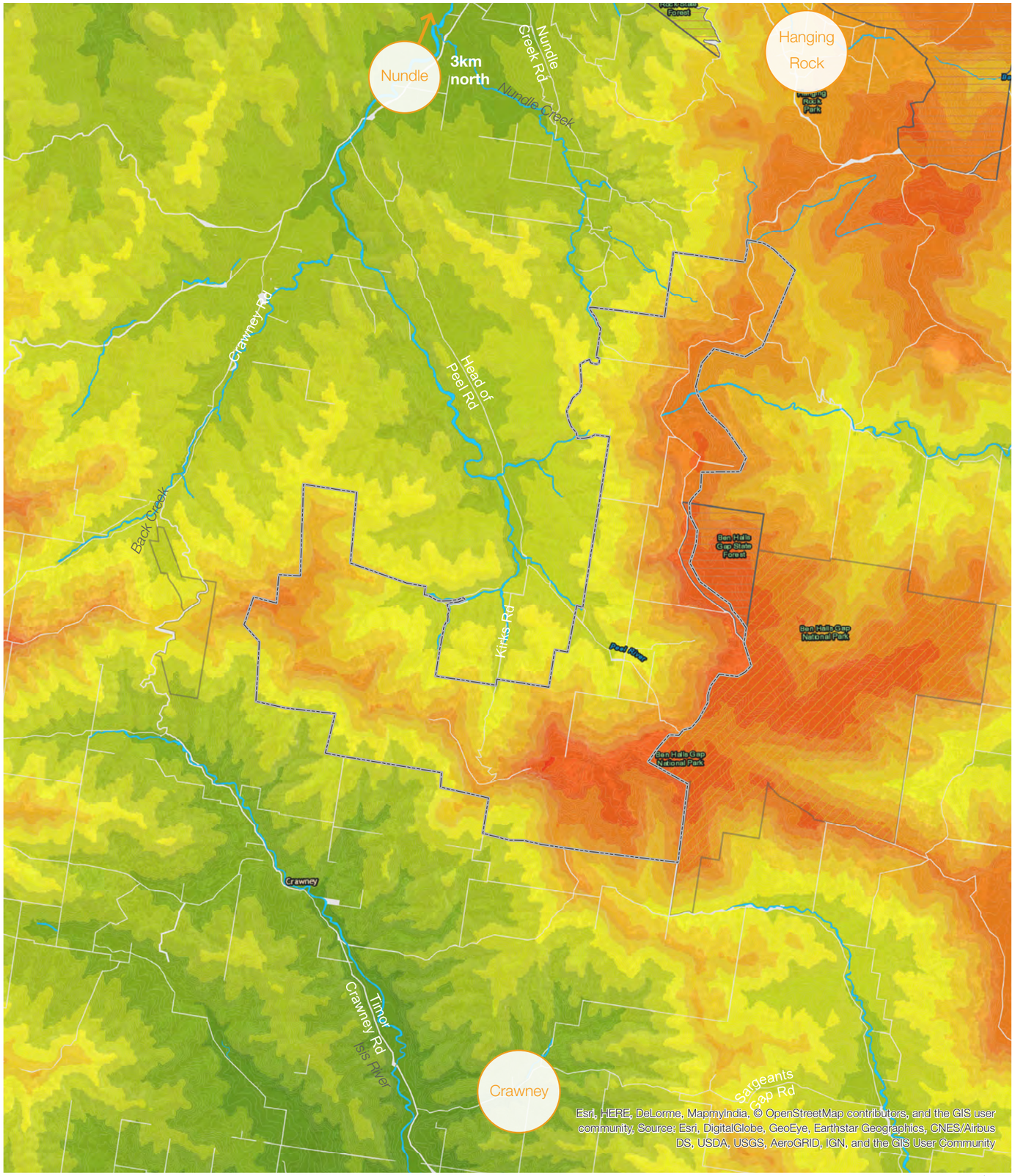
Nundle State Forest is located on south-east boundary of Nundle. It is characterised by a conifer plantation with logging and hunting activity.

LEGEND:

- National Park
- State Forest
- Project boundary

Ben Halls Gap State Forest

Ben Halls Gap State Forest is situated to the north of Ben Halls Gap National Park and occupies and area of approximately **350ha**. The area is characterised by a hardwood forests.



Landscape context

Topography

The substantial mountains of the Great Dividing Range defines the centre of the project area with a range of plateaus, ridgelines and escarpments broadly positioned in an north-south direction, wrapping around the southern extent to Crawney Pass National Park. The undulating foothills decline towards the centre of the project area with creeks and tributaries carving through the landscape, converging at the Peel River and Nundle Creek along Nundle valley floor.

Ben Halls Gap straddling the Great Dividing Range, reaching heights of approximately 1390m AHD, with Crawney Pass National Park marking the western stretch of the study area, reaching heights of approximately 1170 AHD.

Land use

The project area has a strong history of agricultural use, specifically cattle and sheep grazing, classified as ‘Grazing modified pastures’ and ‘Grazing native vegetation.’ Cropping is also recorded to occur along the Nundle valley.

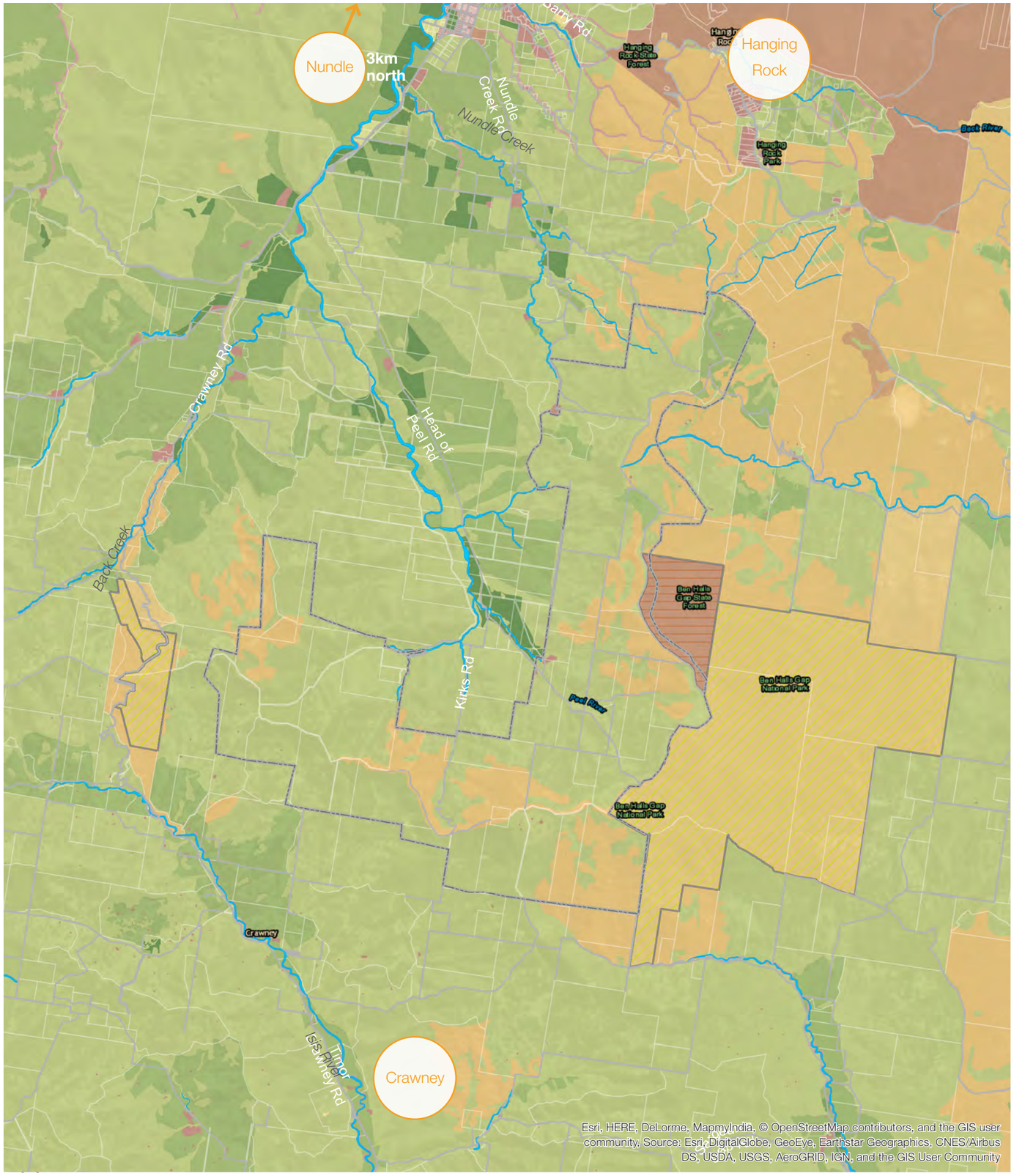
‘Other minimal use’ is predominantly characterised as areas of steep and/or heavily vegetated terrain, offering reduced opportunities for agricultural use.

Areas of hardwood and softwood forestry are present to the north with Ben Halls Gap and Crawney Pass National Park estates to the east and west.

LEGEND:

- National Park
- State Forest
- Project boundary

- Cropping
- Grazing irrigated modified pastures
- Grazing modified pastures
- Grazing native vegetation
- Irrigated cropping
- Managed resource protection
- Manufacturing and industrial
- Mining
- Nature conservation
- Other minimal use
- Perennial horticulture
- Plantation forestry
- Production forestry
- Reservoir/dam
- Residential and farm infrastructure
- River
- Services
- Transport and communication
- Waste treatment and disposal



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Vegetation cover

Vegetation clearing along ridgelines and low lying topography has occurred to create grazing land and room for access roads, tracks and fence lines. Scattered and intermittent tree cover are present within cattle land parcels and along creek lines.

Grassy woodlands dominate the undulating foothills and escarpments with an increase in tree canopy cover towards the forested mountain tops, which are dominated by dense, mature forests, most notably associated with Ben Halls Gap National Park to the east, Hanging Rock to the north and Crawney Pass National Park.

LEGEND:

- National Park
- State Forest
- Project Boundary

- Cleard
- Dry sclerophyll forests
- Forested wetlands
- Freshwater wetlands
- Grassy woodlands
- Heathlands
- Rainforests
- Wet sclerophyll forests

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Landscape Character

Landscape character assessment seeks to divide the landscape into distinct, broadly homogeneous units with defining characteristics. In this way each character area should be distinct from an adjoining area which will be defined by a different set of key parameters. The preliminary Landscape Character Areas (LCAs) identified as part of this assessment have been based on a review of GIS mapping data, including land-use, topography, vegetation cover and aerial photography and will be defined further during the Environmental Impact Assessment. Character areas beyond the immediate project area will also be defined and assessed to document potential impacts that may arise as a result of the introduction of the proposed infrastructure corridors.

A summary of the preliminary LCAs has been provided to the right and are illustrated to the left.

LEGEND:

- Nundle Valley Pasture
- Rolling Foothills
- Forested Mountain Range
- Project boundary

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Nundle valley pasture

Characterised by:

- A landscape modified for agricultural practices
- Low lying gently undulating terrain traversed by tributaries that converge with Peel River and Nundle Creek along the valley floor
- Sense of enclose with surrounding rising topography to the east, south and west associated with the forested mountain ranges
- Intermittent and scattered tree cover within cattle grazing parcels, with denser tree cover along creeks and tributaries

Rolling foothills

Characterised by:

- Transition in topography with ridgelines and elevated crests stretching between the valley floor and the mountain range
- A network of creeks that traverse between the elevated crests
- An increase in vegetation cover with a patchwork of grass woodlands with grass clearings to plateaus

Forested mountain range

Characterised by:

- Densely forested mountain tops to the eastern slopes of the Dividing Range ridgeline, wrapping to the south and east enclosing the low lying terrain
- Ben Halls Gap National Park, Ben Halls Gap State Forest and Crawney Pass National Park
- Eucalypt Forest, wet sclerophyll forest with areas of high quality habitat
- Contrast with open grass plateaus

Visual baseline

Approach

As stated in the methodology and in accordance with the VIA Bulletin, the visual study area has been defined through the preparation of a VEM.

The VEM has been prepared utilising GIS to illustrate the theoretical area from which Hills of Gold Energy project would be visible in the landscape. The associated infrastructure, including substations, hardstand areas, construction compounds, internal access tracks, and high voltage overhead powerline, has not been designed at this stage and will be subject to detailed investigation and assessment during the Environmental Impact Assessment stage.

The VEM is by its nature approximate only and has been prepared to determine the approximate extent of visibility. The terrain data used is based on a 30m gridded digital elevation model (refer to Appendix B for full metadata information), and excludes areas of existing vegetation or localised variations in topography, representing the greatest extent of potential impact.

Within the study area, the undulating terrain and intervening vegetation provides a degree of screening that upon a more detailed assessment, is likely to reduce impacts that may arise from the project. Further detail and assessment of the screening value of these intervening features will be undertaken during the EIS stage.

Representative viewpoints

In accordance with the Visual Impact Assessment Bulletin, detailed consideration has been given to properties within 2.9km (based on the turbine height). For the purposes of this assessment, the detailed analysis area has been extended to 3km, the findings of which are included in Appendix A.

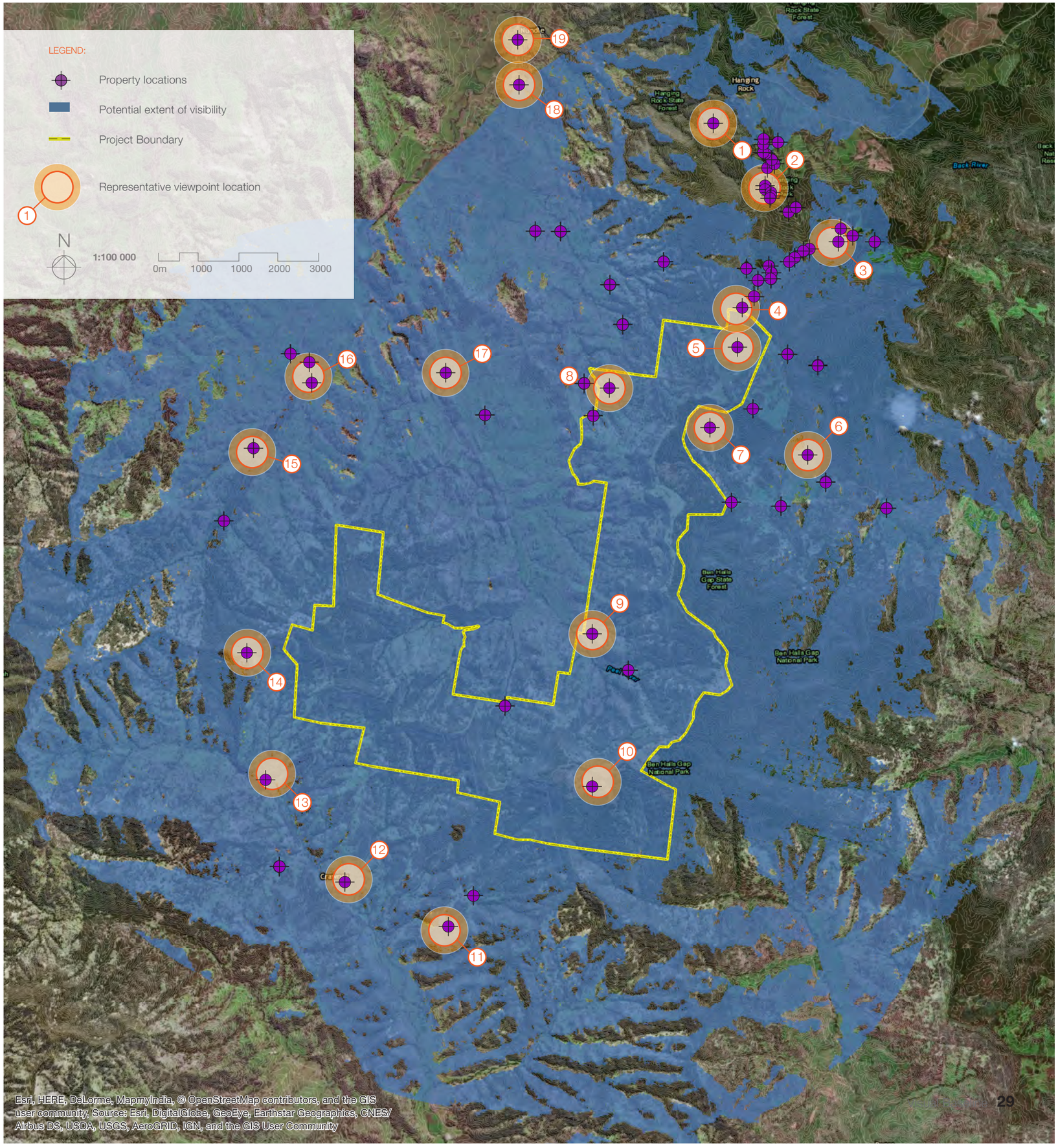
The findings of this detailed analysis will be considered in more detail during the EIS stage, however for the purposes of this preliminary assessment, representative viewpoints have been identified to illustrate a more complete understanding of the project area. A number of these representative viewpoints have been identified as part of the community consultation.

The representative viewpoints are supported with a visual baseline description, photographs from each location and an analysis of the potential magnitude of change that may occur.

The representative viewpoint locations are illustrated to the right with the detailed analysis outlined within section 3. “Visual Impacts” within this report.

Representative viewpoints

1. Hanging Rock lookout
2. Properties situated on Barry Road
3. Properties situated on Barry Road (east)
4. Properties situated on Morrisons Gap Road
5. Properties situated on Morrisons Gap Road (further south)
6. Properties situated on Shearers Road
7. Arc-en-Ciel Trout Farm
8. Properties situated on Nundle Creek Road
9. Properties situated on Nundle Creek Road
10. Property along Morrisons Gap Road (H16)
11. Property along Mountain View Road (H17)
12. Properties along Timor Crawney Road (UH19)
13. Properties along Timor Crawney Road (H32)
14. View from Crawney Pass National Park (Ridge Trail)
15. View from properties along Crawney Road (UH14)
16. View from properties along Crawney Road (UH17)
17. Properties along Head of Peel Road (UH6)
18. Southern edge of Nundle
19. Nundle Town



04

Potential Impacts

Potential landscape and visual impacts that may arise from the Hills of Gold Energy project.

LEGEND:

- Nundle Valley Pasture
- Rolling Foothills
- Forested Mountain Range
- Project boundary

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Landscape Impacts

This chapter documents a preliminary understanding of the potential change that may arise and provides a summary of matters which will require further investigation, assessment, management and mitigation as part of the full Environmental Impact Assessment.

Landscape Character Areas

Nundle valley pastures

The low lying, modified agricultural landscape is considered to be valued at a local level as an important agricultural resource.

Direct impacts on the Nundle valley pastures LCA are not anticipated to arise from the turbines, however the turbines will contrast with the perceived sense of remoteness and enclosure offered by the surrounding foothills and mountainous range, and therefore has the potential to result in an indirect effect on the character of the area.

Further investigation

During the EIS stage, further consideration will be given to the location of substations and overhead powerlines, which have the potential to directly effect this LCA.

Rolling foothills

The topography and ridgelines offer an agricultural function considered to be valued at a local level.

Turbines located within this LCA have the potential to become the dominant visual feature in the landscape. The direct impact arising from the turbines is likely to result in a localised reduction the agricultural land, although this will increase with the provision of access roads and additional infrastructure.

Further investigation

During the EIS stage, further consideration will be given to the location of associated infrastructure, specifically access roads, substations and overhead powerlines, which have the potential to directly effect this LCA.

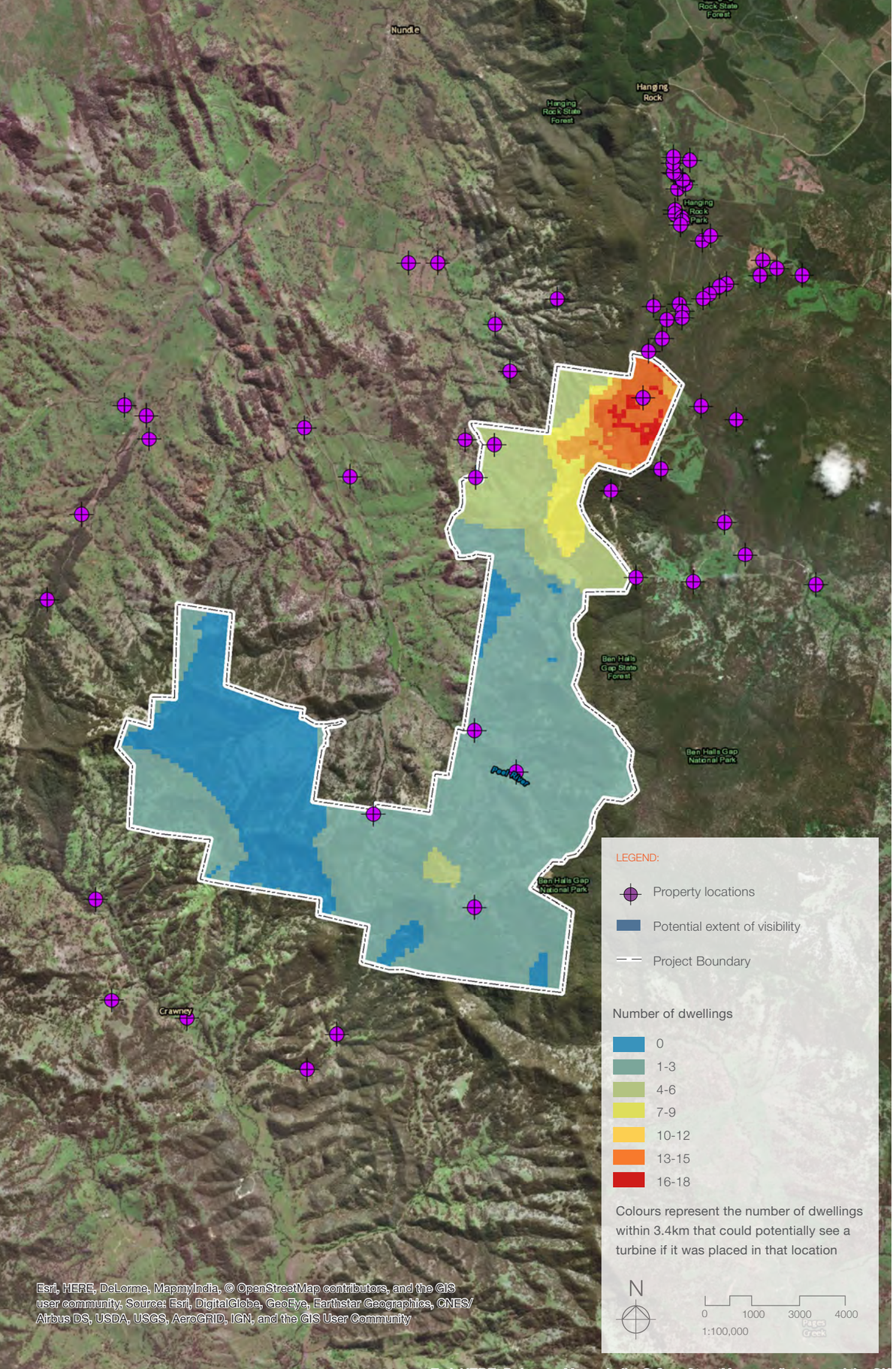
Forested mountain range

This LCA offers a high degree of perceived naturalness, remoteness and inaccessibility, with the value of the landscape in areas considered to be of a national level inherent to the National Parks status, and state level inherent to State Forests.

Turbines located within this LCA have the potential to result in vegetation removal within Ben Halls Gap State Forest resulting in a direct impact. Vegetation removal has the potential to increase with the provision of access roads and additional infrastructure.

Further investigation

During the EIS stage, careful consideration will be given to the siting and design of the turbines and associated infrastructure.



Visual Impacts

This chapter documents a preliminary understanding of the potential impacts that may arise and provides a summary of matters which will require further investigation, assessment, management and mitigation as part of the full Environmental Impact Assessment.

As stated under Section 2, the visual analysis has been approached in three ways;

1. ***VEM based on the development area boundary*** *(illustrated on page 35).*

   Analysis illustrates the varying extent of potential project visibility in the surrounding landscape.

2. ***VEM to determine the number of dwelling that have the potential to experience views towards the development area*** *(illustrated to the left).*

   Analysis illustrates the number of properties that have the potential to see a turbine within a particular location within the development boundary. The analysis will inform the design development stage in advance of the Environmental Impact Assessment, with a particular focus on the siting of turbines to the north of the site.

   The analysis highlights areas within the development corridor requiring further assessment (i.e. sections of the development corridor that are visible to dwellings beneath the black line '3 km' and the number of dwellings that can see a particular location).

3. ***VEMs from dwelling locations to determine the potential extent of visibility from each dwelling*** *(illustrated on the proceeding pages)*

   Detailed analysis of each of the properties and lookout points in accordance with the VIA Bulletin, documenting the degree to which dwellings may be impacted by the wind farm development. The detailed analysis for each property is included in Appendix A.

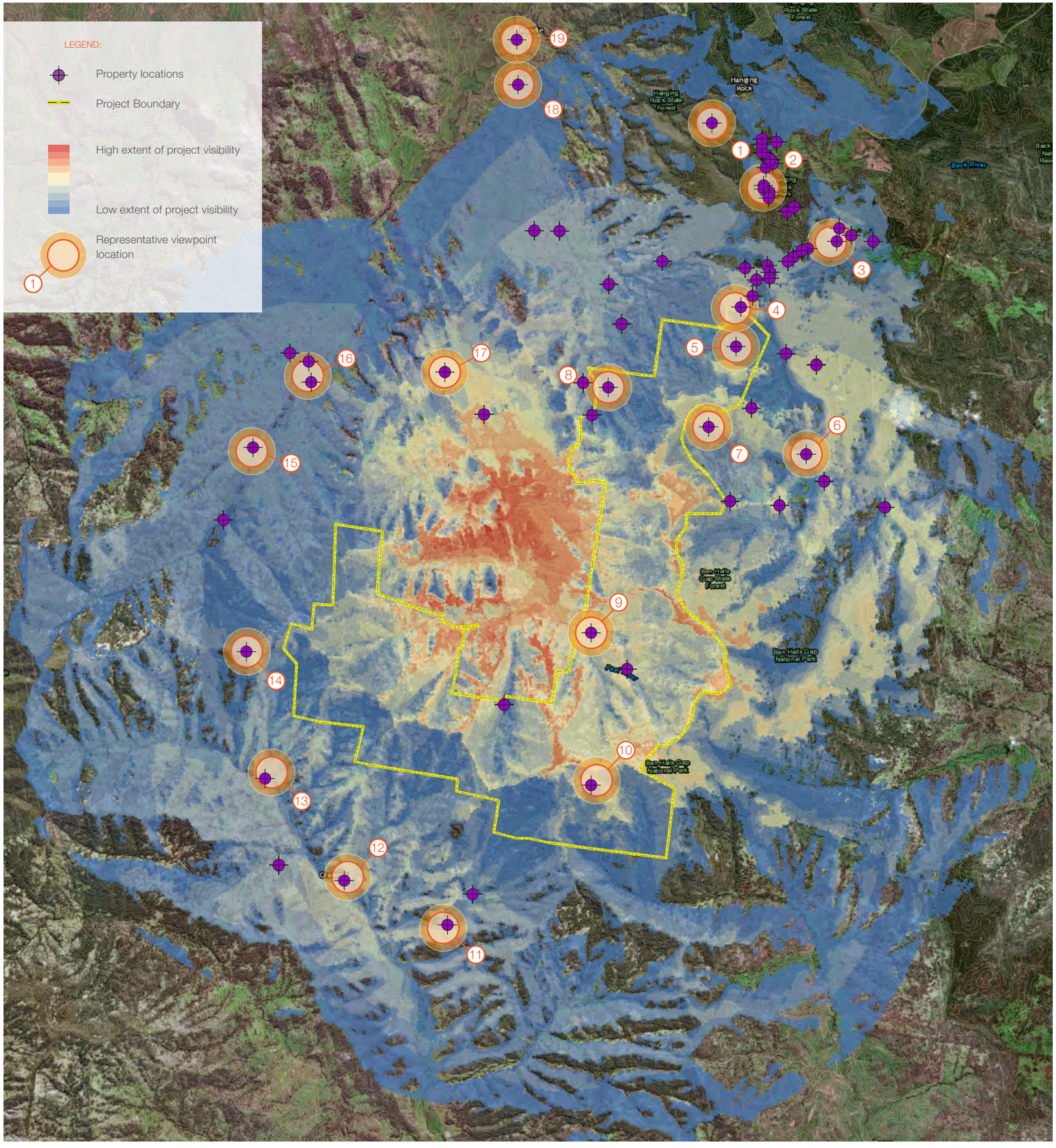
   From this analysis, representative viewpoints have been selected to provide:

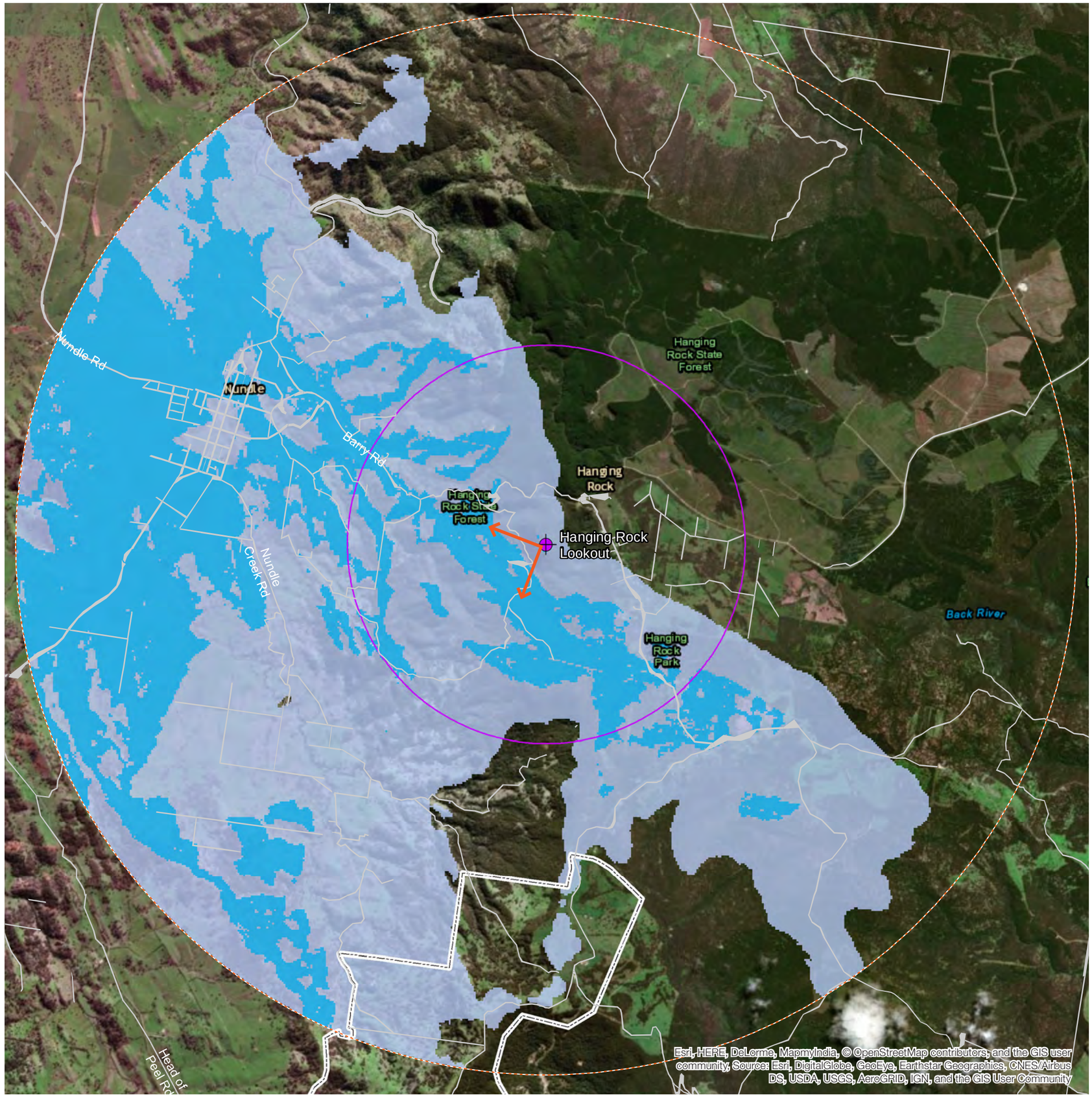
   - Visual baseline descriptions
   - Representative photographs towards the project area
   - Analysis of the potential magnitude of change.

The VEMs are based on bare earth DTM data, excluding intervening features such as vegetation, which is considered to represent the worst case scenario.

Representative viewpoints

1. Hanging Rock lookout
2. Properties situated on Barry Road
3. Properties situated on Barry Road (east)
4. Properties situated on Morrisons Gap Road
5. Properties situated on Morrisons Gap Road (further south)
6. Properties situated on Shearers Road
7. Arc-en-Ciel Trout Farm
8. Properties situated on Nundle Creek Road
9. Properties situated on Nundle Creek Road
10. Property along Morrisons Gap Road (H16)
11. Property along Mountain View Road (H17)
12. Properties along Timor Crawney Road (UH19)
13. Properties along Timor Crawney Road (H32)
14. View from Crawney Pass National Park (Ridge Trail)
15. View from properties along Crawney Road (UH14)
16. View from properties along Crawney Road (UH17)
17. Properties along Head of Peel Road (UH6)
18. Southern edge of Nundle
19. Nundle Town





Representative Viewpoint 1

Hanging Rock Lookout

N

0 0.5km 1km 2km

- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)

60 degree sectors in which wind turbines are potentially visible from the dwelling

Baseline visual description

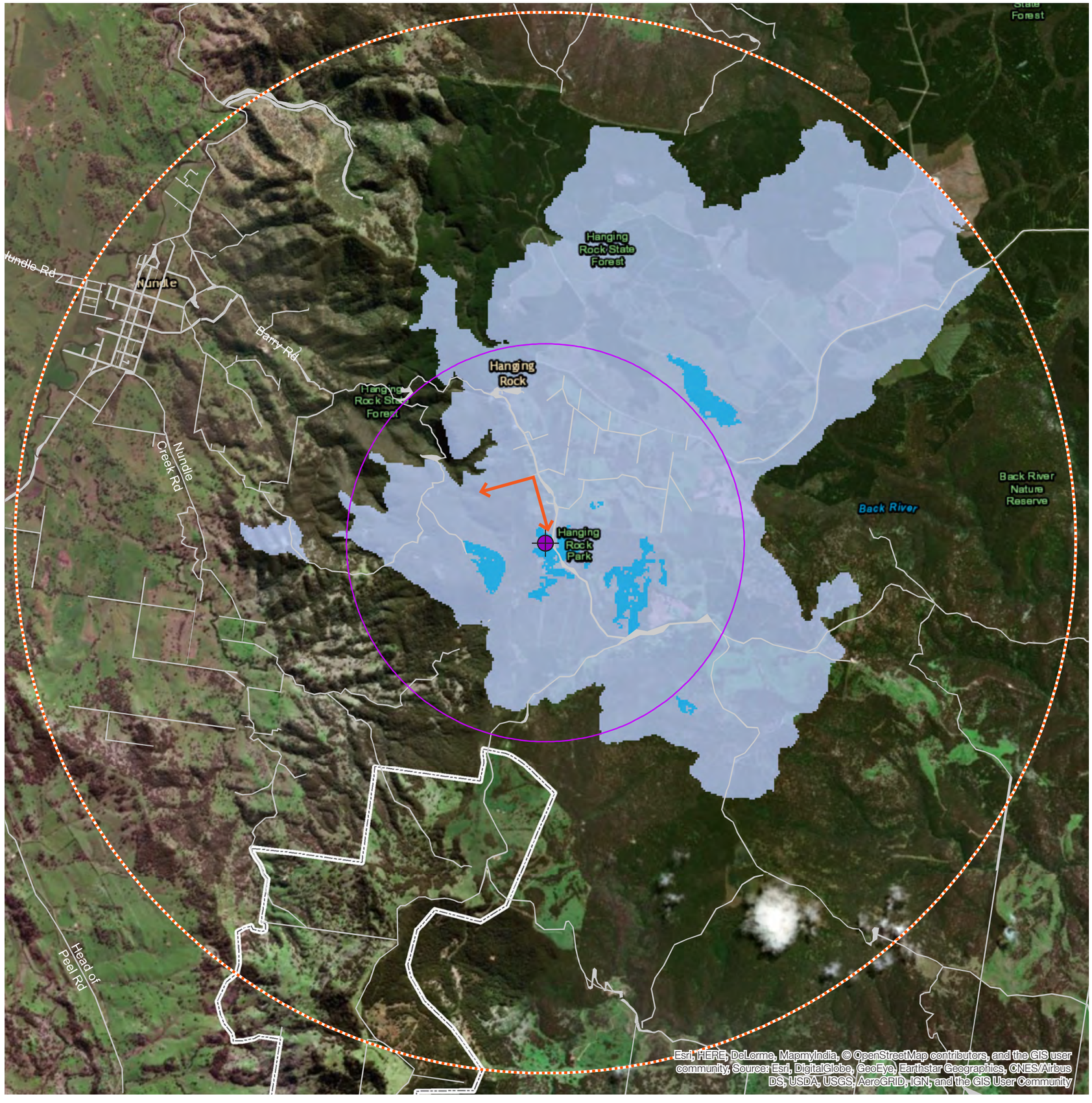
- Elevated view primarily looking west from Hanging Rock Lookout.
- View across forested undulating terrain, including Hanging Rock State Forest, towards Nundle valley floor. Rising terrain visible in the distance.
- View directly south achievable, although filtered by vegetation.

Potential impacts

- The wind farm development boundary would be situated approximately 4690m to the south.
- Turbines are anticipated to be visible from this location, although vegetation adjacent to the lookout would filter views. No turbines would be visible within 3km.
- Impact will arise from the introduction of vertical elements in a rural landscape setting.

Further investigation

During the EIS stage, further consideration will be given to the location of substations and overhead powerlines, which have the potential to be visible traversing the valley floor.



Representative Viewpoint 2

N

0 0.5km 1km 2km

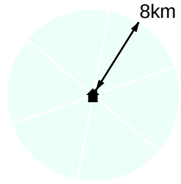
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from properties along Barry Road.
- Mature vegetation associated with forested mountain terrain reduces and filters views to the south and east.
- Views of distant ridgelines achievable above mature tree canopy.

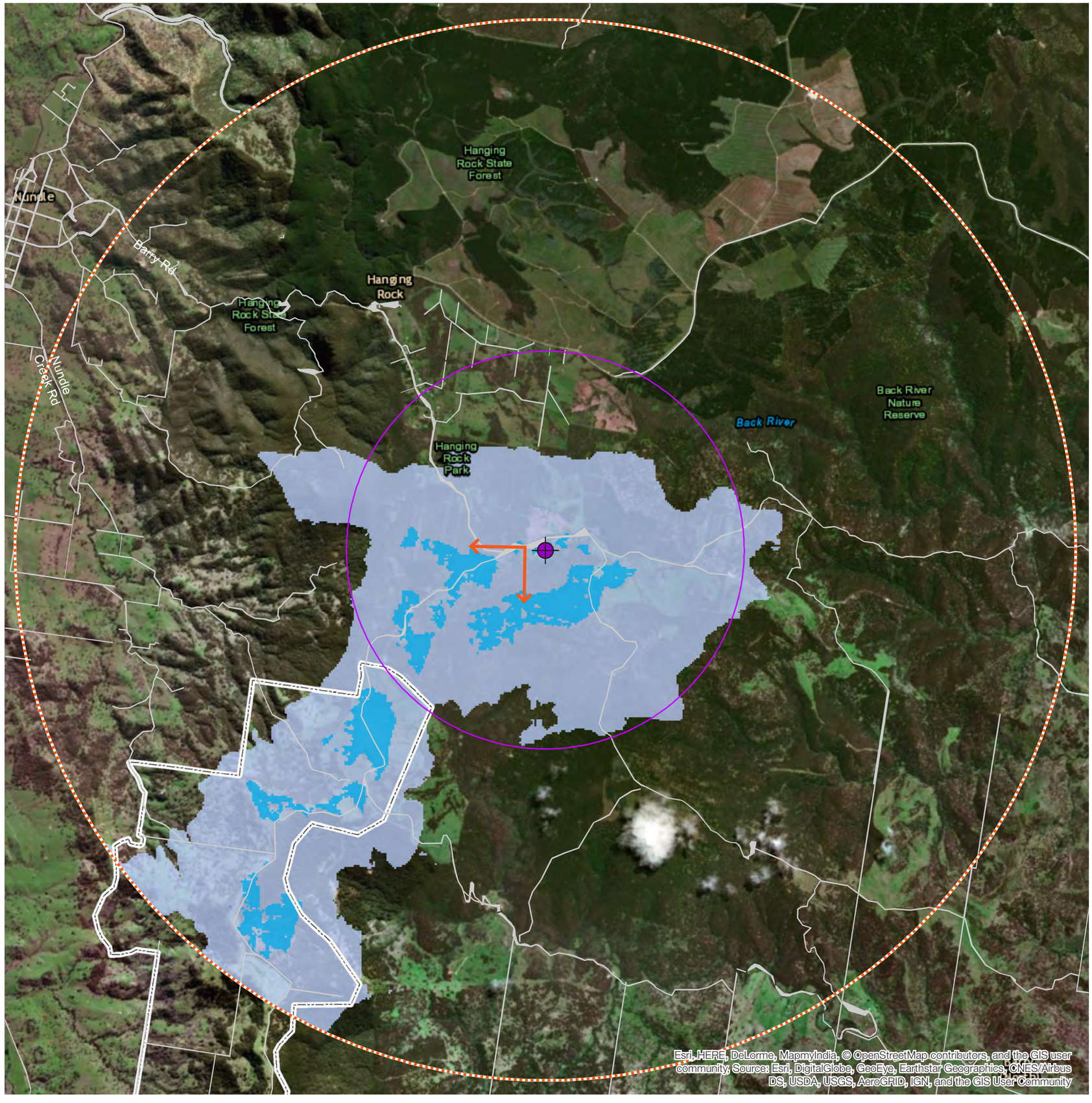
Potential impacts

- The wind farm development boundary would be situated approximately 3225m to the south.
- Wind farm is not anticipated to be visible from this location.

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Consideration will be given to preparing a photomontage to confirm the location and any potential visibility of turbines on the horizon.



Representative Viewpoint 3

N

0 0.5km 1km 2km

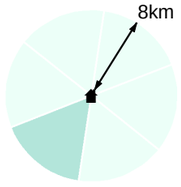
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from properties along Barry Road.
- Mature vegetation associated with forested mountain terrain reduces and filters views to the south and east.
- Views of distant ridgelines achievable above mature tree canopy.

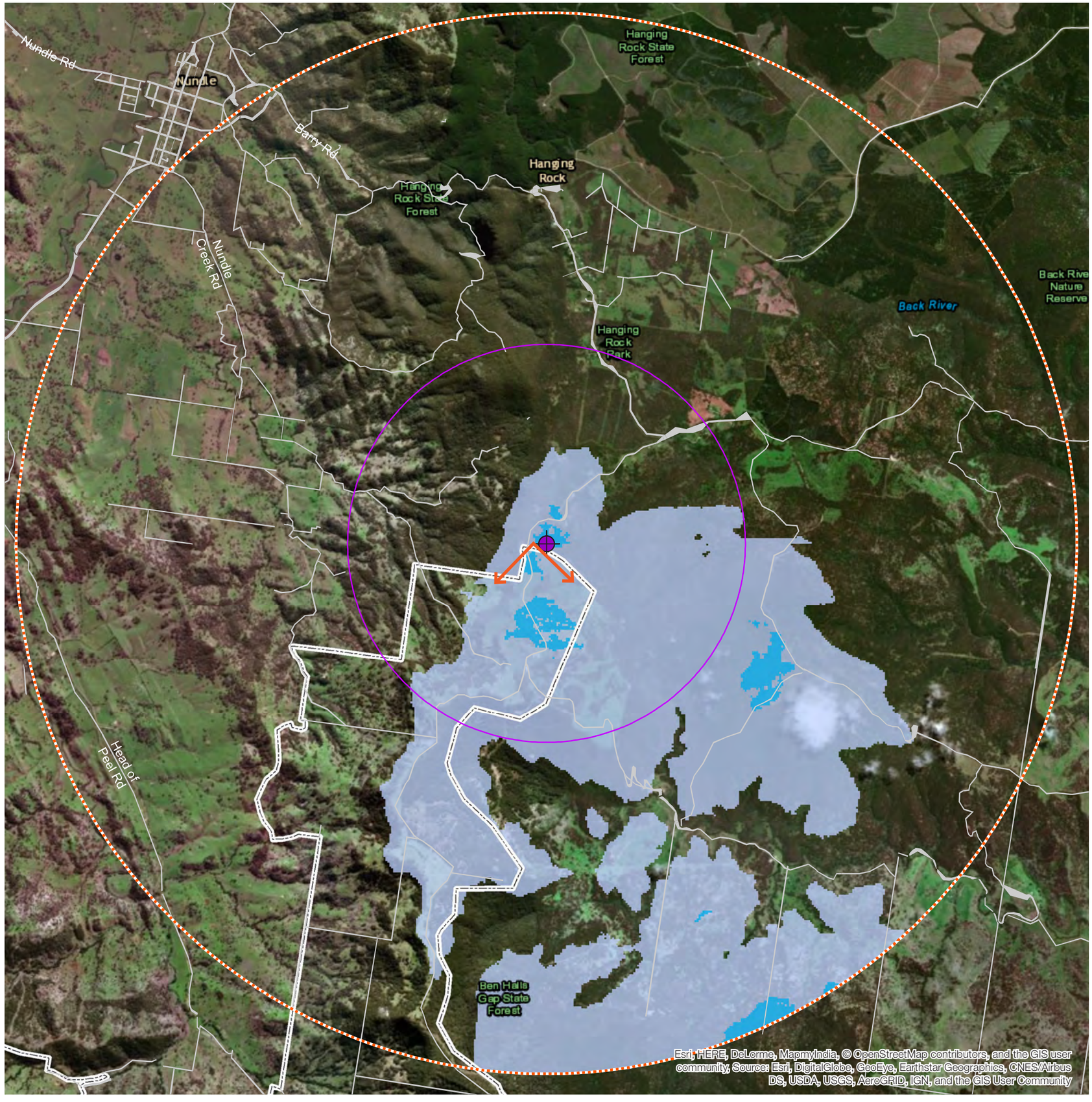
Potential impacts

- The wind farm development boundary would be situated approximately 896m to the south west.
- Turbines are anticipated to be visible, although partially filtered by intervening vegetation.
- No turbines would be visible within 3km.

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Where possible, access will be agreed with land owners to confirm the visual outlook and potential impacts from properties within this location.



Representative Viewpoint 4

N

0 0.5km 1km 2km

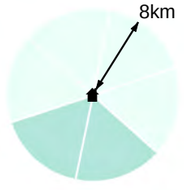
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from properties along Morrisons Gap Road (property H1).
- View south from top of private access road through opening in vegetation along overhead powerline corridor.
- View to cleared plateau on mountain top with intermittent trees.

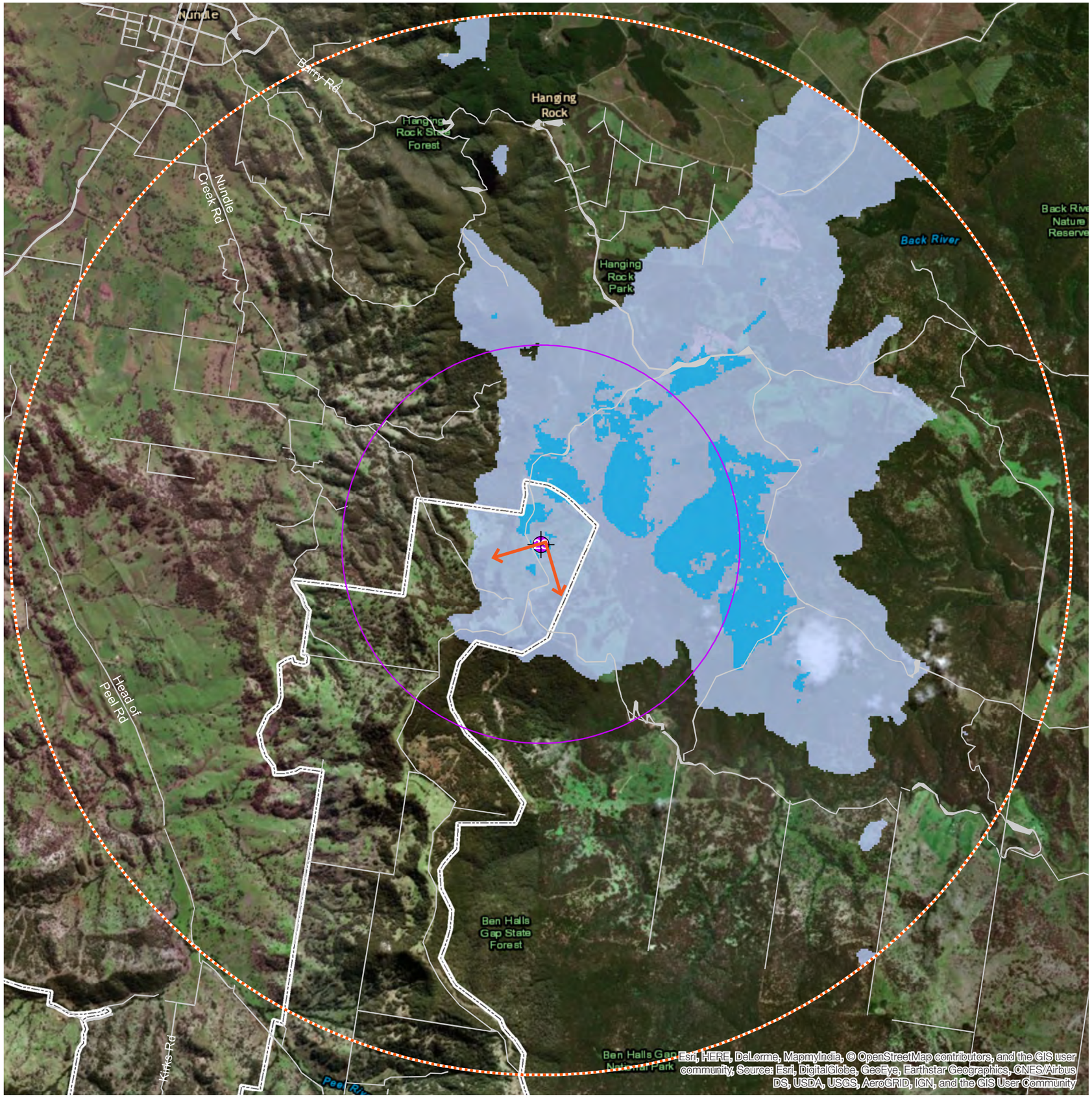
Potential impacts

- The wind farm development boundary would be situated approximately 114m to the south.
- A clear view from elevated position to the wind farm development boundary is anticipated from this locations.

Further investigation

This representative viewpoint illustrates an open and exposed view from Morrisons Gap Road. Vegetation along Morrison Gap Road to the north and south of this viewpoint is anticipated to assist with screening and reducing visibility towards the wind farm. Further detailed analysis will be undertaken during the EIS stage to capture the anticipated extent of visibility.

To assist, consideration will be given to preparing a photomontage to confirm the location and visibility of turbines on the horizon.



Representative Viewpoint 5

N

0 0.5km 1km 2km

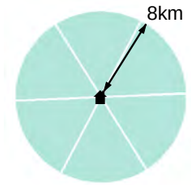
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Baseline visual description

- Representative view from associated landowners property along property drive way.
- Property situated on a cleared plateau. Localised topographical undulation to the immediate south of the property.
- Tree lined access road with scattered trees in adjoining agricultural land.

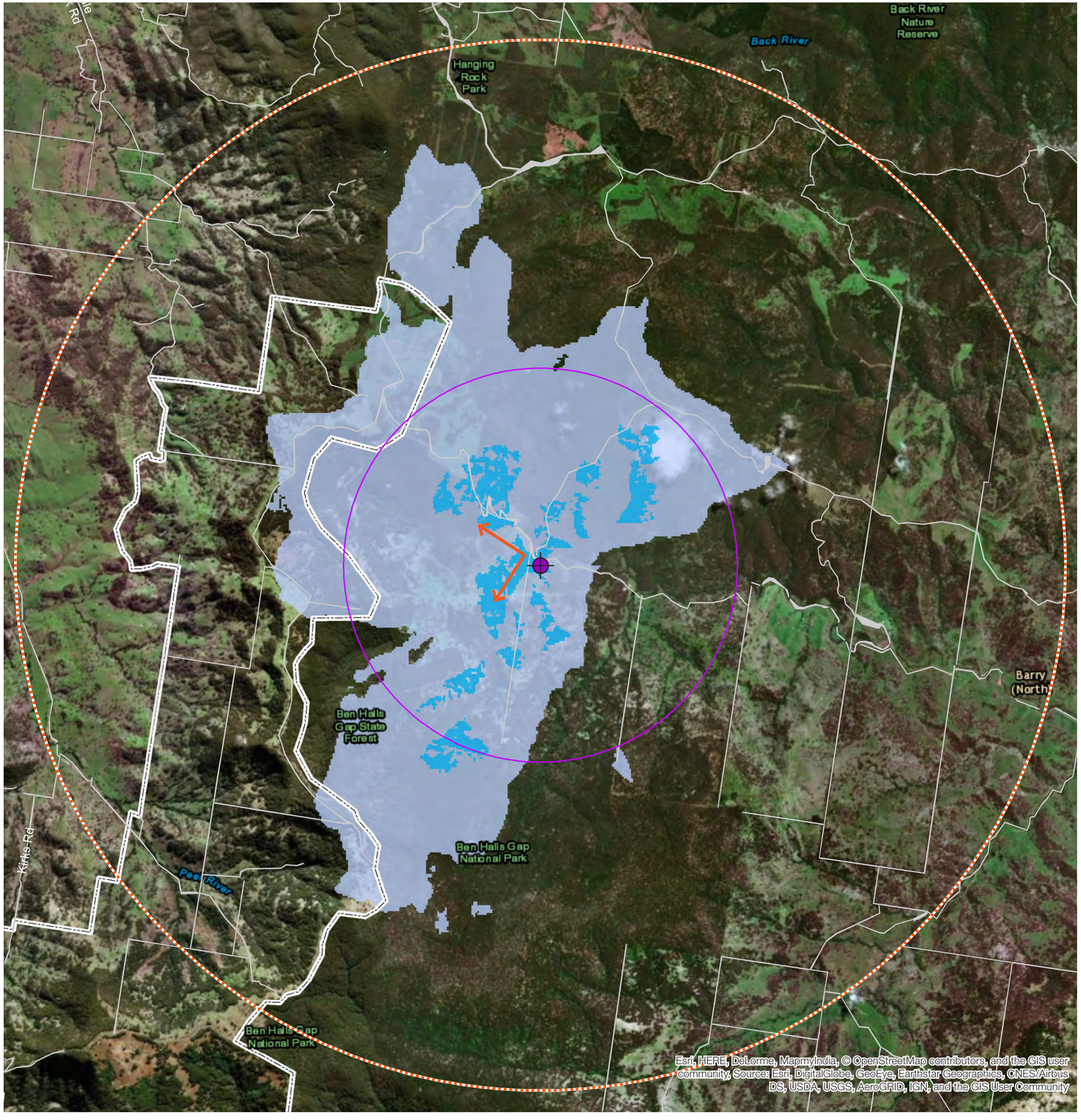
Potential impacts

- This property would be situated within the wind farm development boundary.
- It is anticipated that wind turbines would be situated in close proximity and would be fully visible from this location.

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Consideration will be given to preparing a photomontage to confirm the location and visibility of turbines on the horizon.



Representative Viewpoint 6

N

0 0.5km 1km 2km

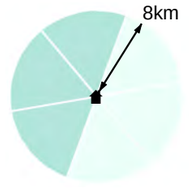
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from properties along Shearers Road.
- Properties situated on the eastern slopes of the mountainous terrain.
- Views west to rising terrain in the foreground with tree cover to the crest.
- Forest blankets the mountainous terrain to the north.

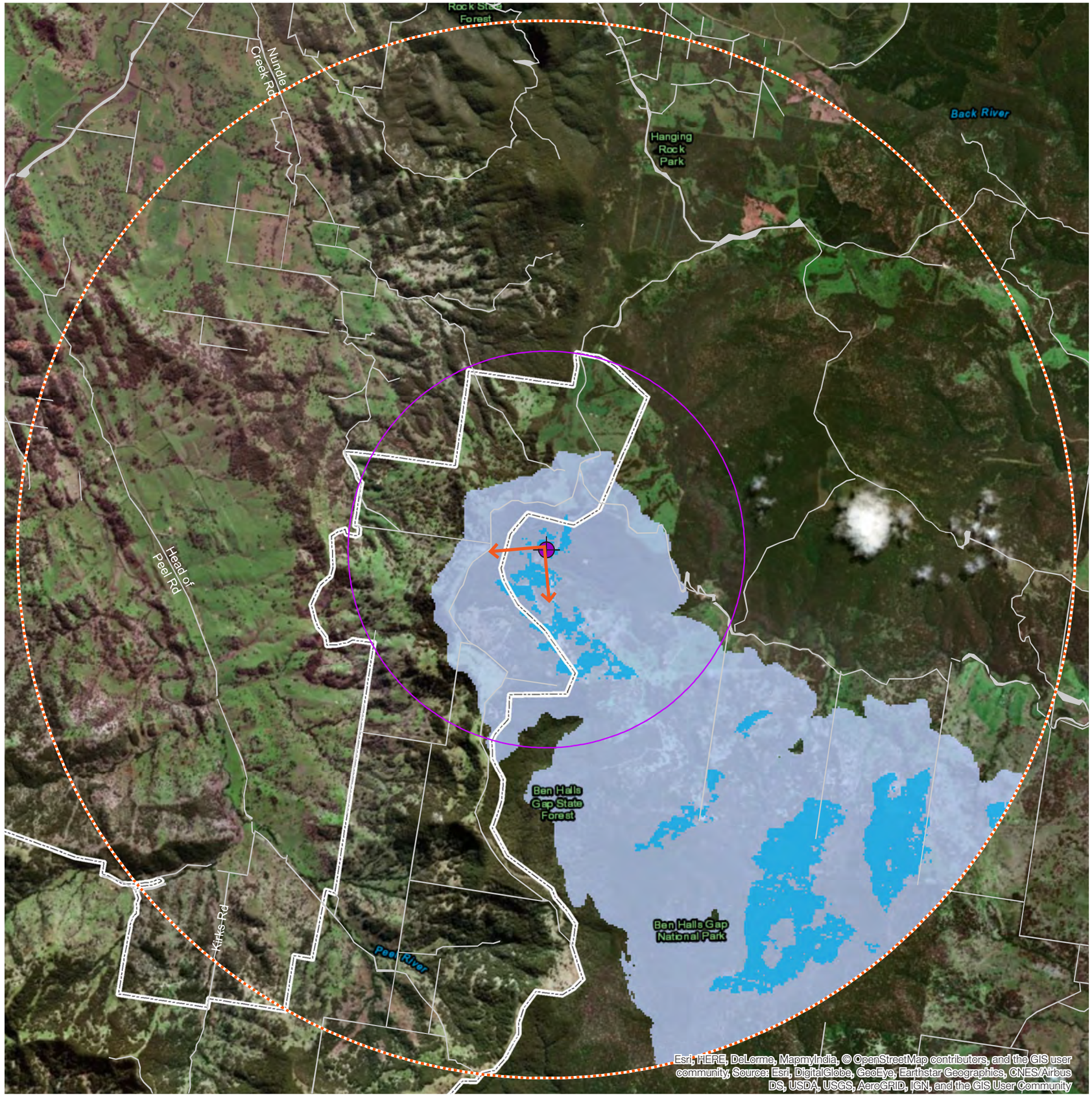
Potential impacts

- The wind farm development boundary would be situated approximately 2518m to the west.
- Wind turbines would potentially be visible to the west from this location.

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Detailed assessment of the screening value of intervening vegetation through the preparation of a photomontage.



Representative Viewpoint 7

N

0 0.5km 1km 2km

- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)

60 degree sectors in which wind turbines are potentially visible from the dwelling

Baseline visual description

- Representative view from associated landowner (Arc-en-Ciel Trout Farm).
- Location heavily enclosed by mature vegetation to all sides with the topography rising to the north.

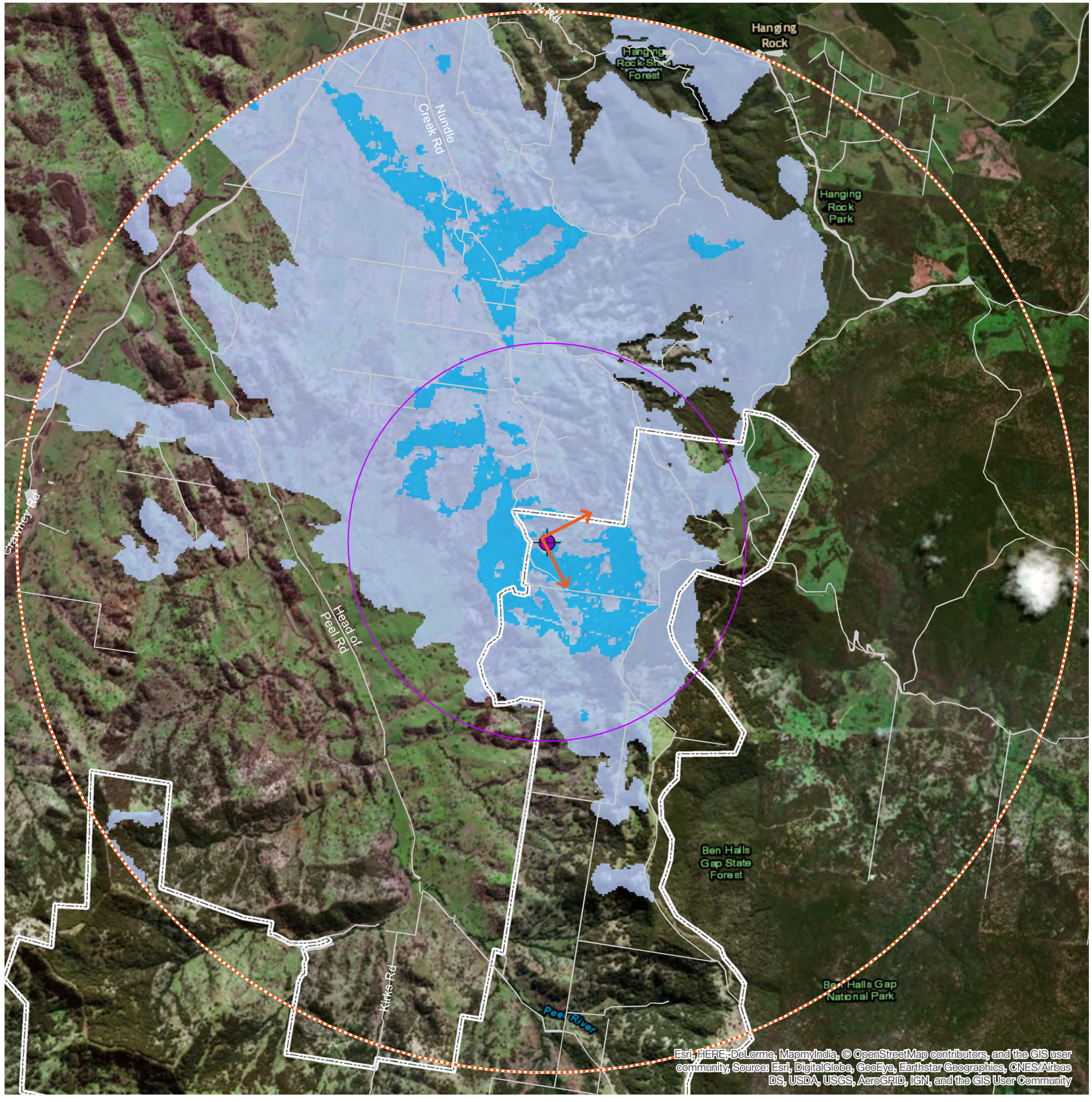
Potential impacts

- The wind farm development boundary would be situated approximately 462m to the south, west and north.
- It is anticipated that wind turbines would potentially be visible above the existing vegetation.

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Detailed assessment of the screening value of intervening vegetation through the preparation of a photomontage.



Representative Viewpoint 8

N

0 0.5km 1km 2km

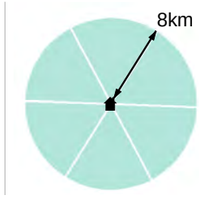
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from the end of Nundle Creek Road on an associated landowners land (property H22). Properties along Nundle Creek Road have varying degrees of visibility (refer to Appendix A for property analysis)
- View from the undulating agricultural foothills with the topography rising to the range to the east, blanketed with mature vegetation

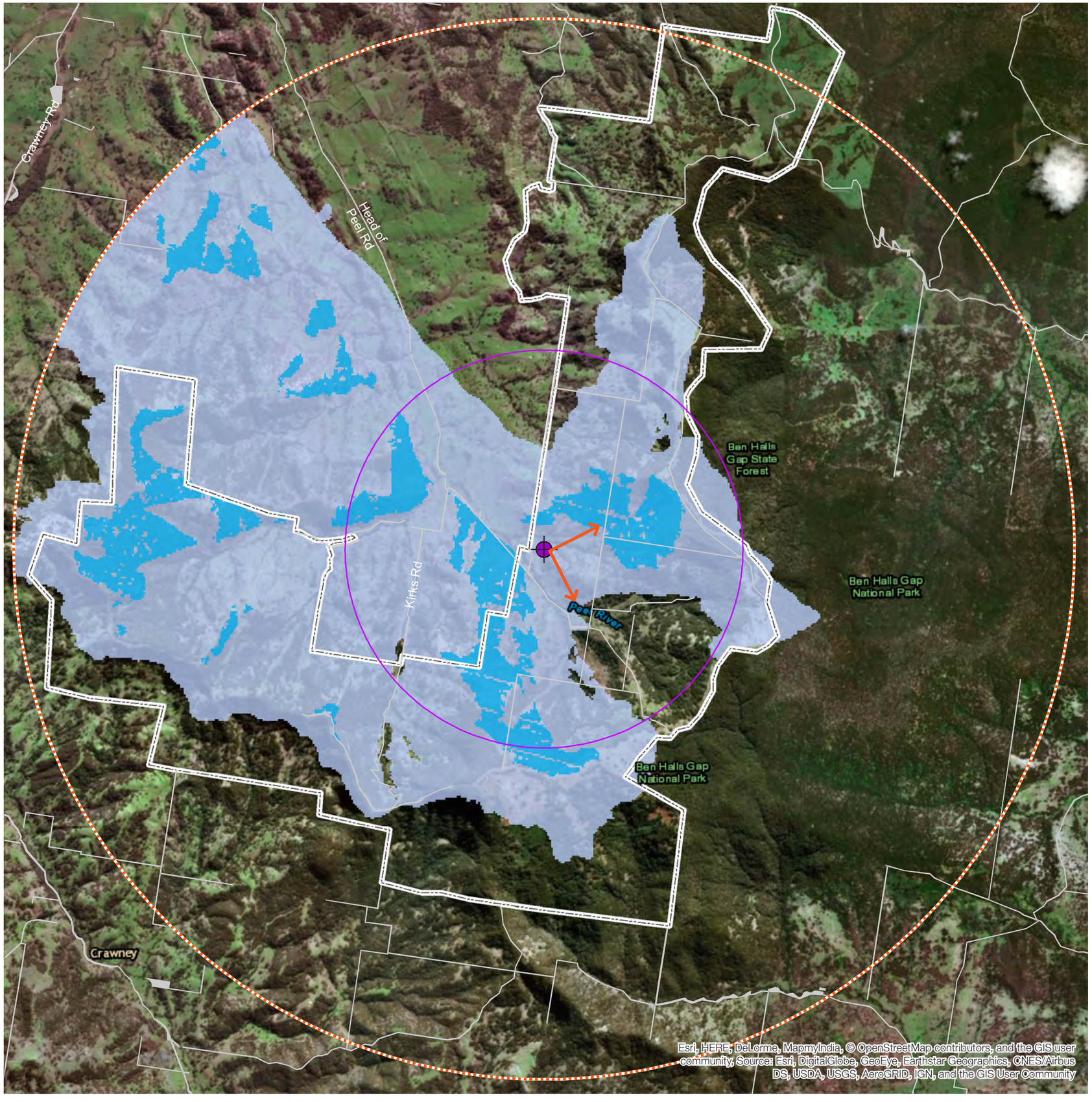
Potential impacts

- This property would be situated within the wind farm development boundary.
- It is anticipated that wind turbines would potentially be visible along ridgelines.

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Detailed assessment of the screening value of intervening vegetation through the preparation of a photomontage.



Representative Viewpoint 9

N

0 0.5km 1km 2km

Representative viewpoint location

Potential dwelling location

Expected project boundary

Ground level viewshed

220m above ground level viewshed

8km radius from dwelling

3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)

60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from the driveway of associated landowner (H23) from Head of Peel Road
- View across undulating foothills rising to the range blanketed with mature vegetation
- Vegetation marks the location of creek lines in the foreground of the view

Potential impacts

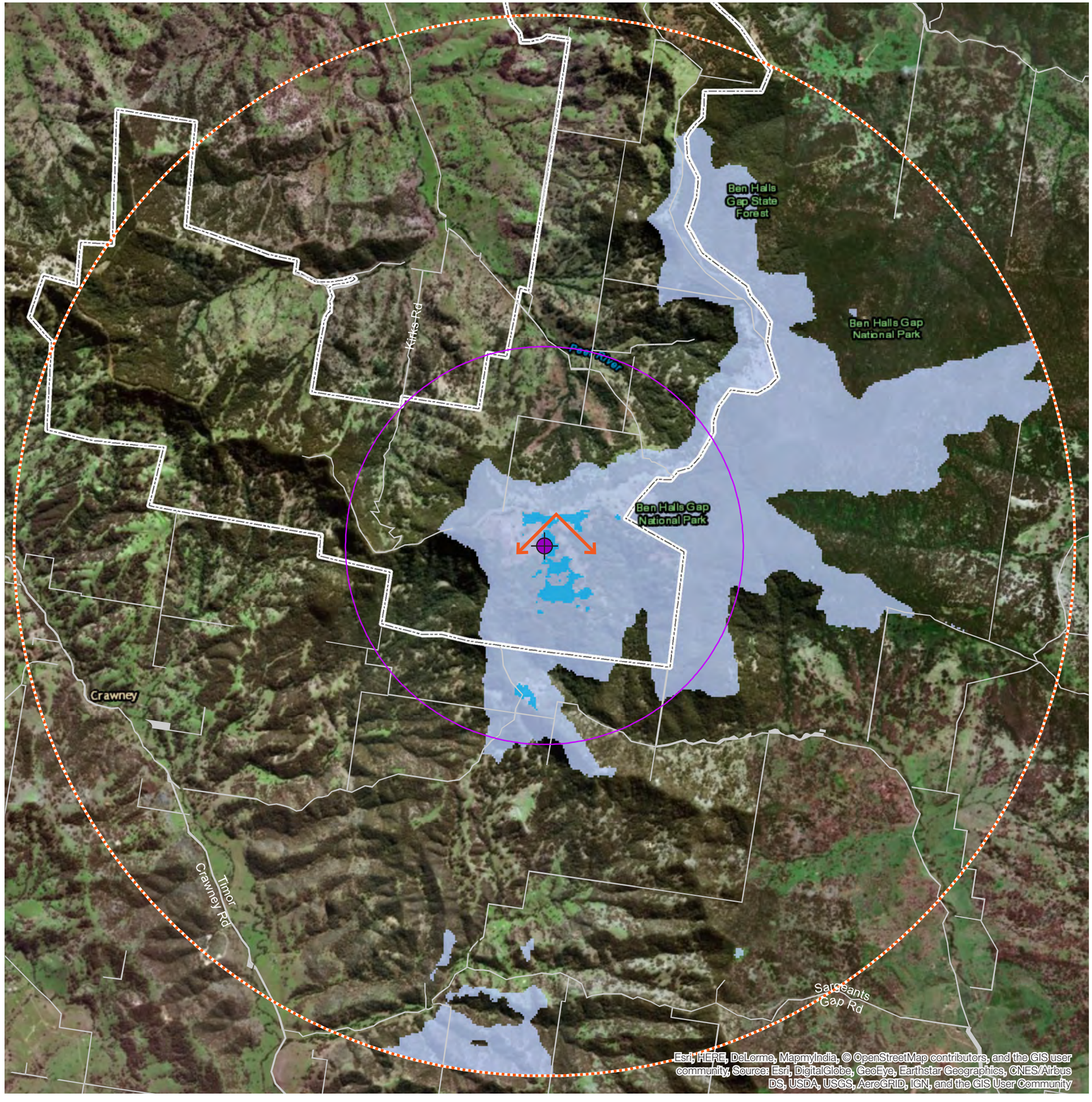
- The representative viewpoint would be situated within the wind farm development boundary
- It is anticipated that wind turbines would potentially be visible along ridgelines to the east

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines

Detailed assessment of the screening value of intervening vegetation through the preparation of a photomontage

Exploration of the delivery of localised planting to reduce impacts arising from the visibility of turbines



Representative Viewpoint 10

N

0 0.5km 1km 2km

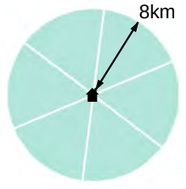
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view towards associated landowner (H16)
- Property enclosed by mature vegetation with waterbody to the northwest of the property.

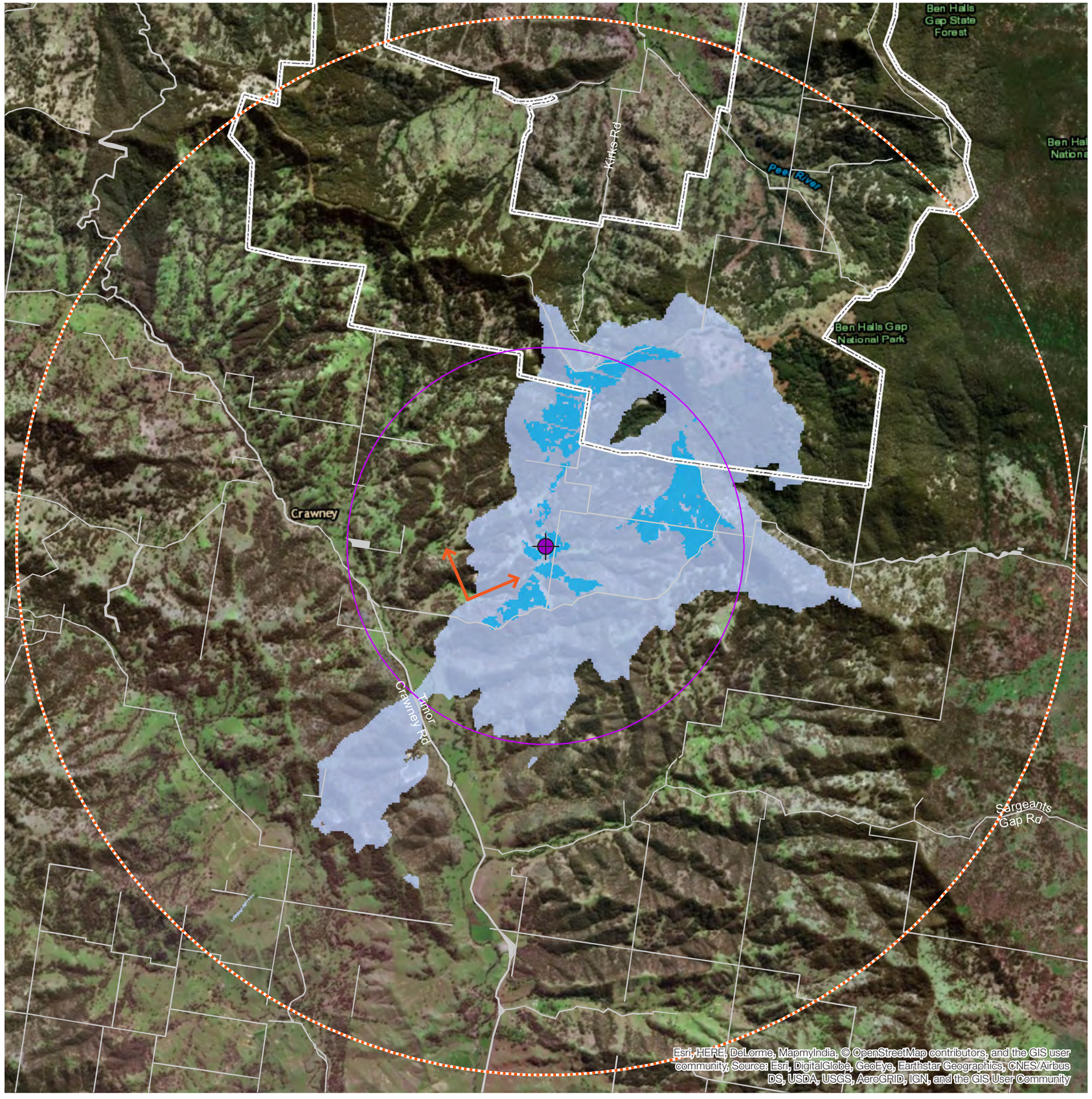
Potential impacts

- The property would be situated within the wind farm development boundary
- It is anticipated that wind turbines would potentially be visible above the existing vegetation to the north, south, east and west of this location

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Detailed assessment of the screening value of intervening vegetation through the preparation of a photomontage.



Representative Viewpoint 11

N

0 0.5km 1km 2km

- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)

60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from property along Mountain View Road (H17). Photo taken from gated access road (south west of property location)
- Location enclosed by mature vegetation to the northwest with vegetation blanketing the undulating foothills to the north

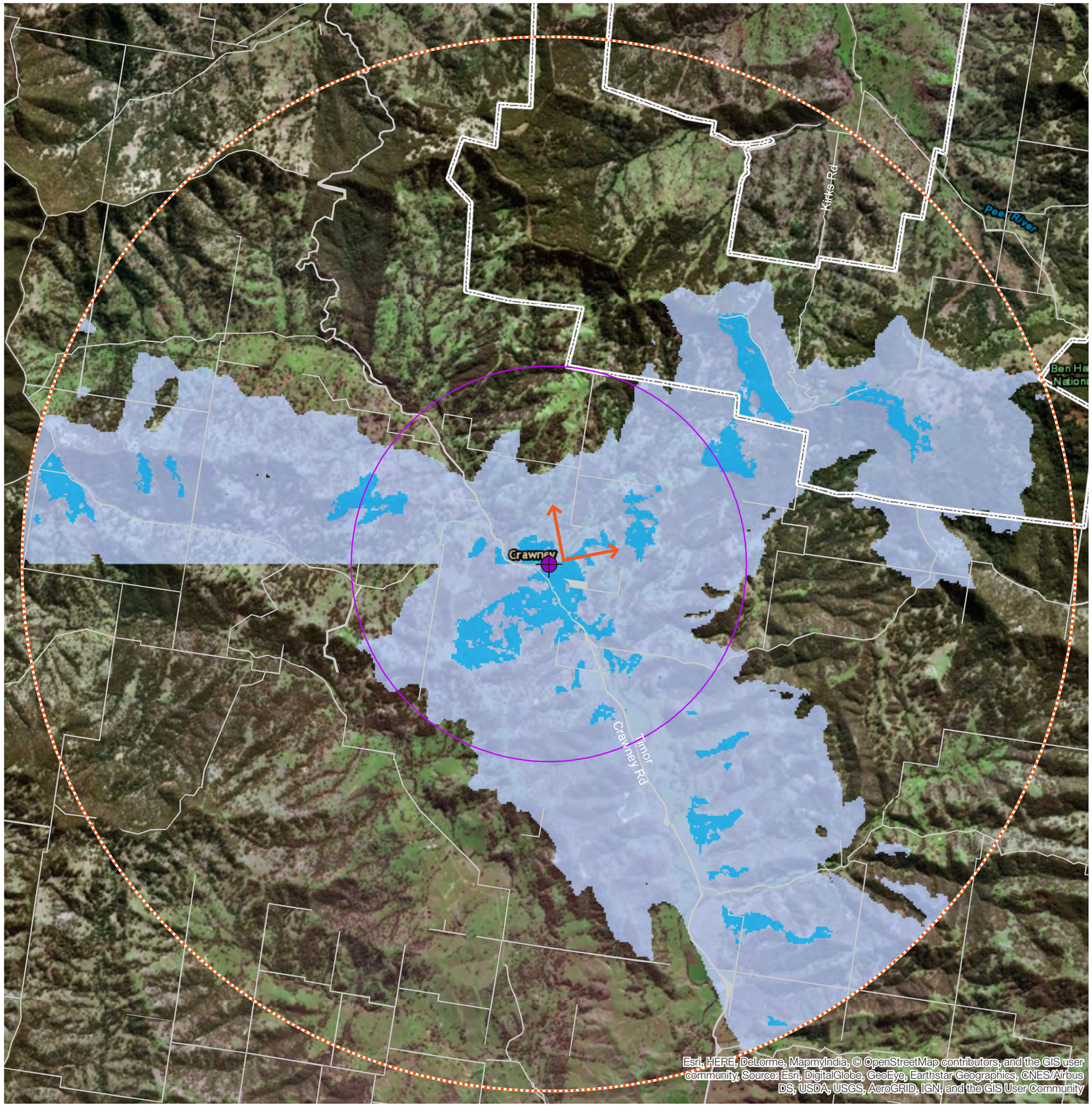
Potential impacts

- The wind farm development boundary would be situated approximately 1650m to the north of the property.
- It is anticipated that wind turbines would potentially be visible above the existing vegetation to the north and north east.

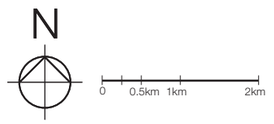
Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Detailed assessment of the screening value of intervening vegetation through the preparation of a photomontage.



Representative Viewpoint 12



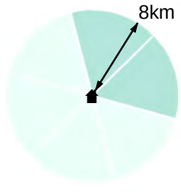
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from associated landowner along Timor Crawney Road View Road (UH19).
- View north to cleared undulating topography with intermittent trees
- Distant view to forested mountain tops marking the skyline

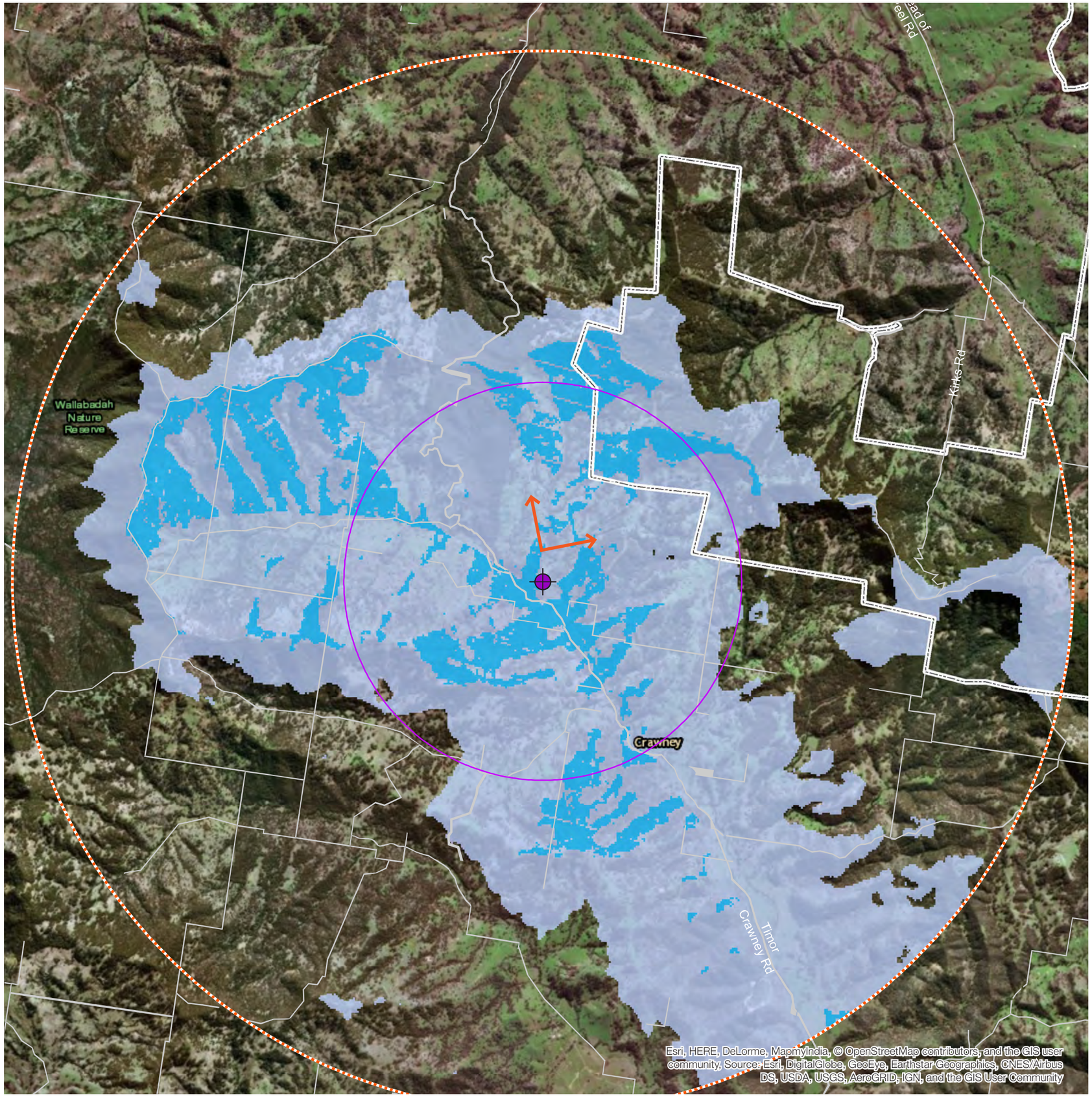
Potential impacts

- The wind farm development boundary would be situated approximately 3000m to the north
- It is anticipated that wind turbines would potentially be visible to the north above the undulating topography and along the ridgeline in the distance

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Detailed assessment of the screening value of intervening vegetation through the preparation of a photomontage.



Representative Viewpoint 13

N

0 0.5km 1km 2km

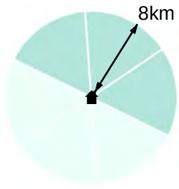
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

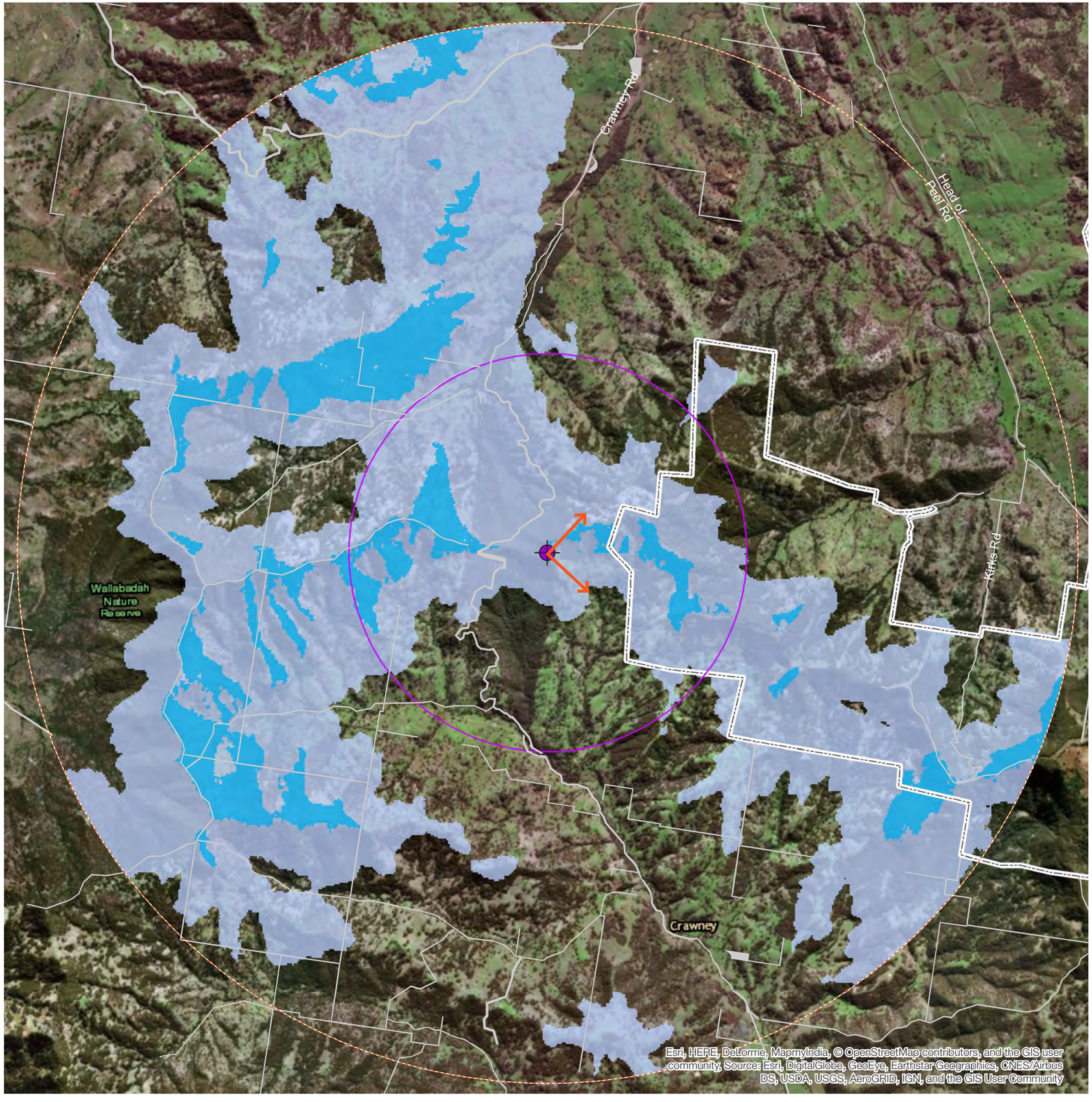
- Representative view from associated landowner along Timor Crawney Road View Road (H32).
- View north across partially cleared undulating agricultural land with scattered tree cover, particularly in lower areas along creek lines
- Distant view to mountain tops on the skyline blanketed with mature vegetation

Potential impacts

- The wind farm development boundary would be situated approximately 1738m to the north
- It is anticipated that wind turbines would potentially be visible to the north above the undulating topography and along the ridgeline in the distance

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.



Representative Viewpoint 14

N

0 0.5km 1km 2km

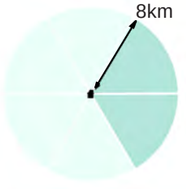
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from all areas of Crawney Pass National Park and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from Crawney Pass National Park (Ridge Trail)
- Elevated views from the trail to the north, east and west, frequently filtered by mature vegetation

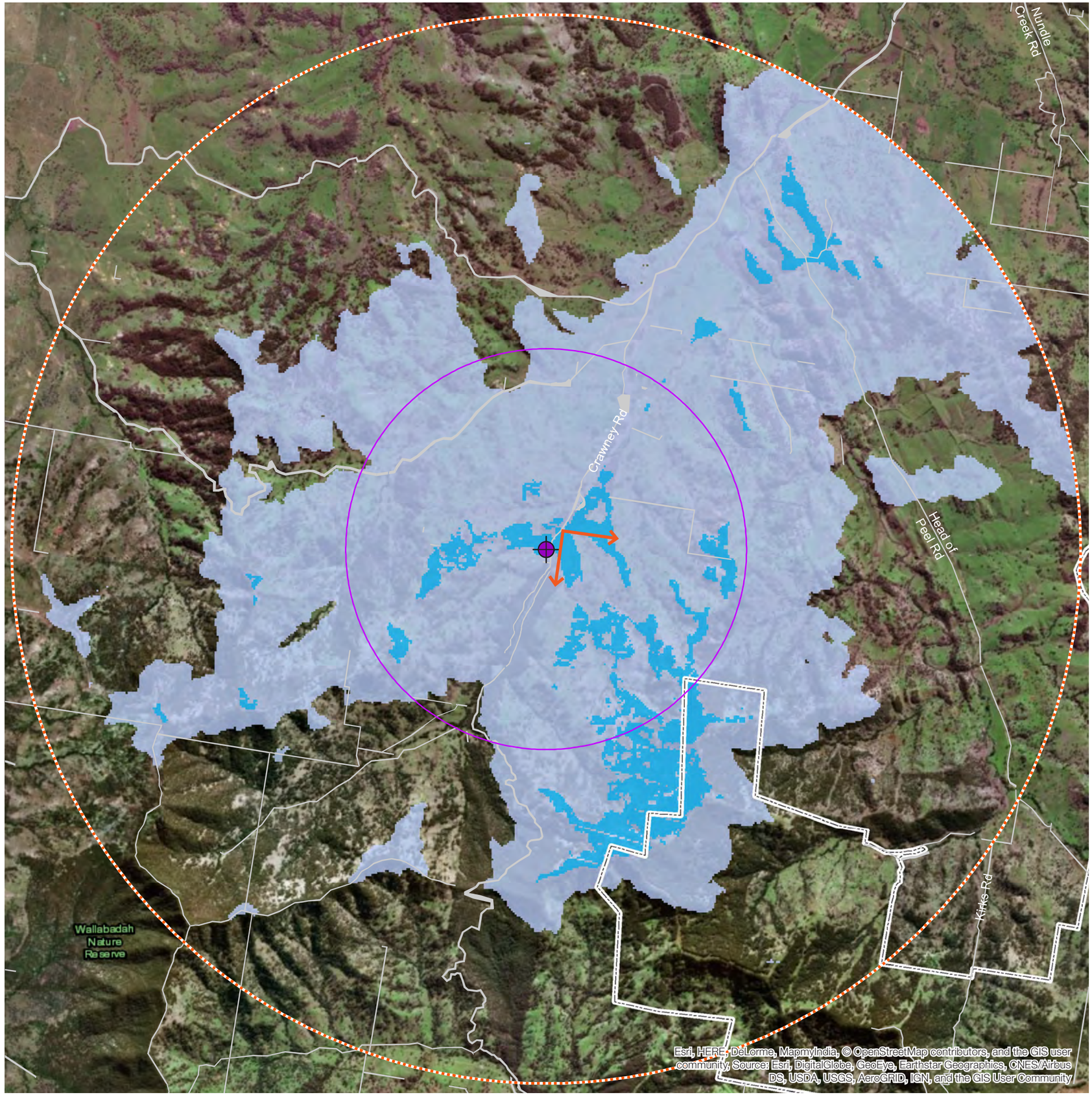
Potential impacts

- The wind farm development boundary would be situated approximately 925m to the east
- It is anticipated that wind turbines would potentially be visible to the east, although existing vegetation would filter or limit views towards a number of turbines.

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Detailed assessment of the screening value of intervening vegetation through the preparation of a photomontage.



Representative Viewpoint 15

N

0 0.5km 1km 2km

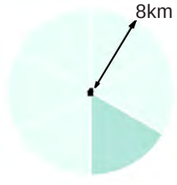
- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from properties along Crawney Road (UH14)
- Open view east across cleared agricultural parcels with mature vegetation lining Wombramurra Creek in the foreground

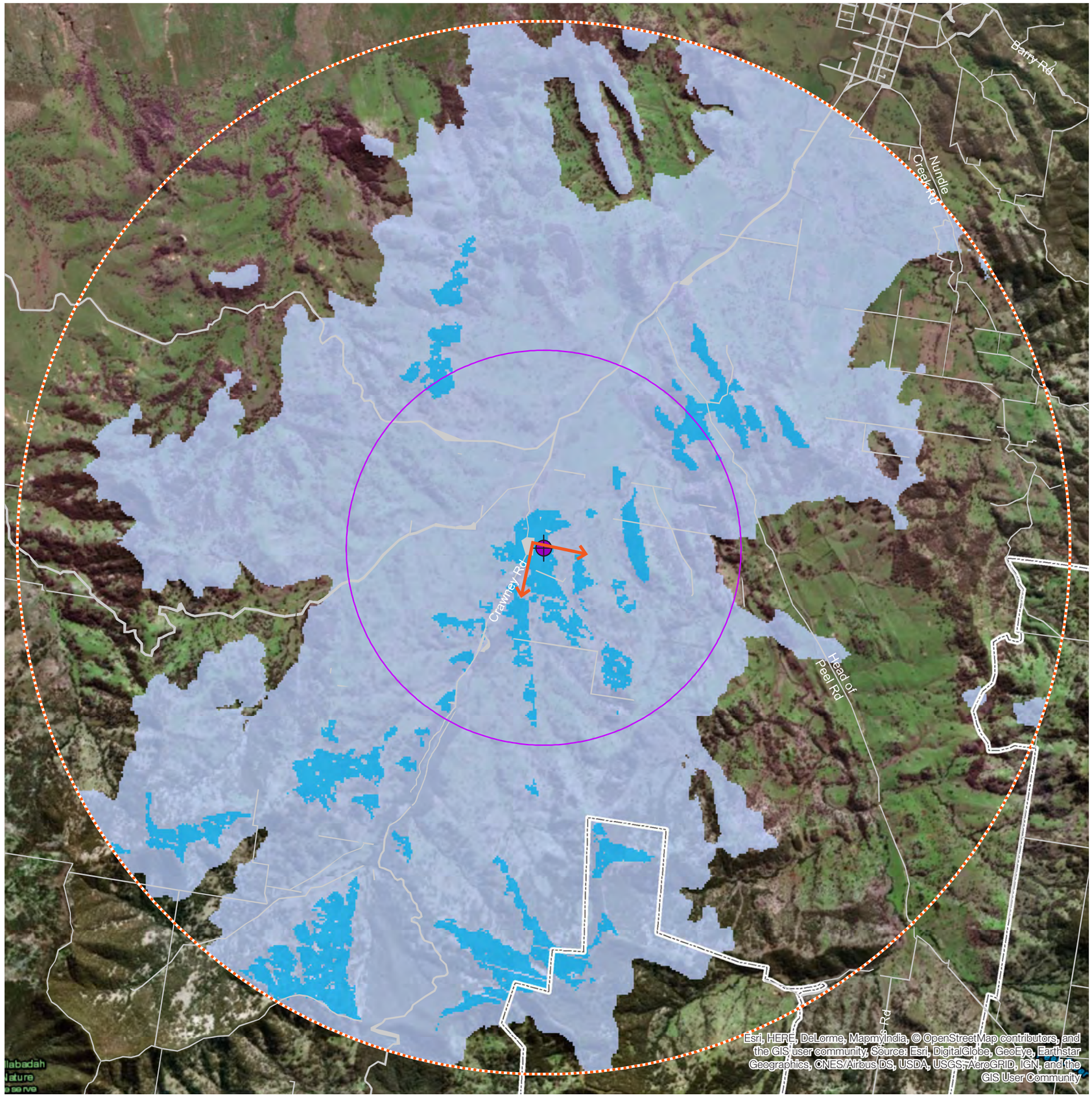
Potential impacts

- The wind farm development boundary would be situated approximately 2845m to the south east
- It is anticipated that wind turbines would potentially be visible along the ridgeline and the undulating terrain
- No turbines would be present within a 3km radius of this property

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Detailed assessment of the screening value of intervening vegetation through the preparation of a photomontage.



Representative Viewpoint 16

N

0 0.5km 1km 2km

- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)

60 degree sectors in which wind turbines are potentially visible from the dwelling

Baseline visual description

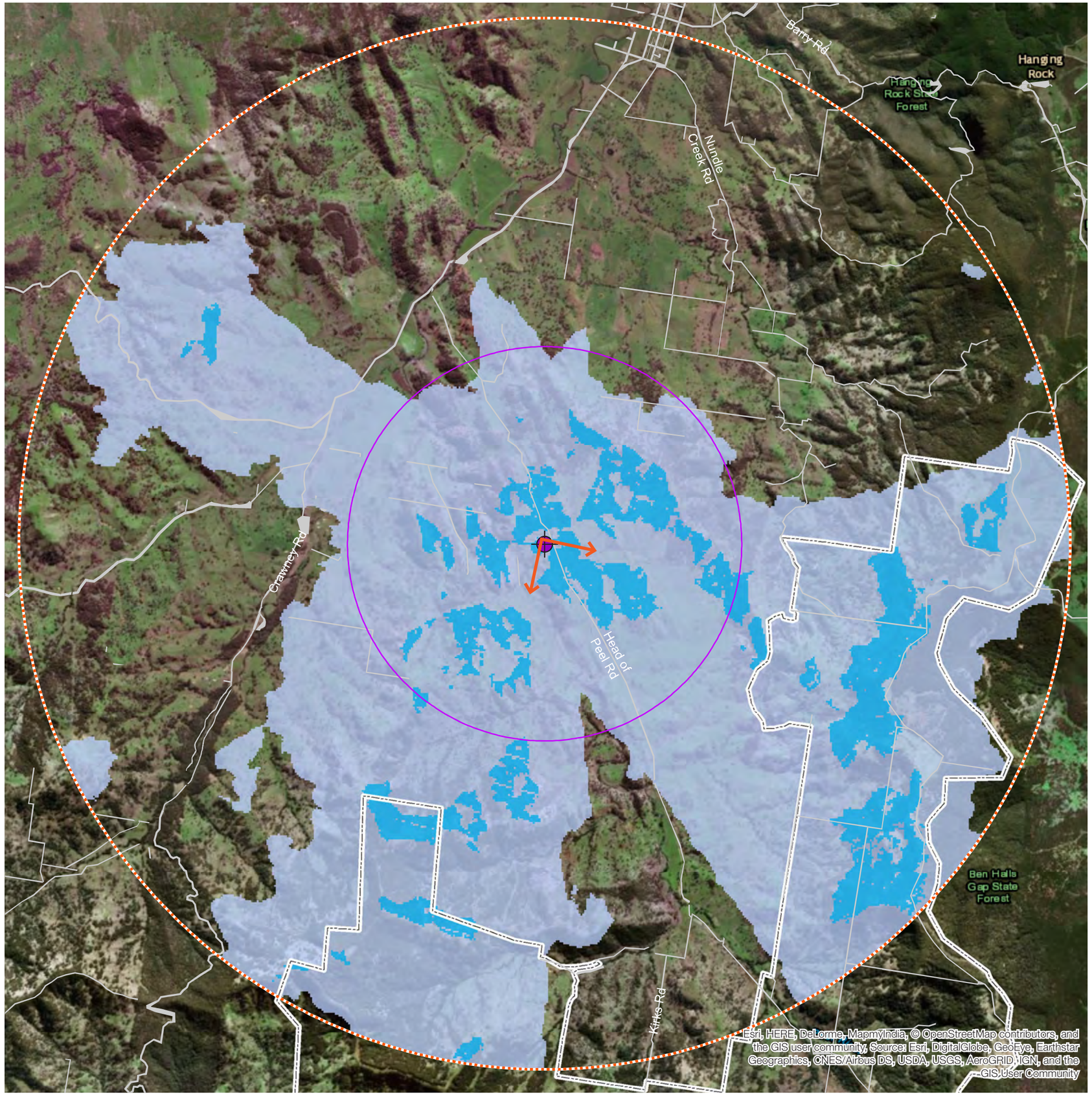
- View from properties along Crawney Road (UH17).
- Open view east across cleared agricultural parcels with mature vegetation lining Wombramurra Creek in the foreground.

Potential impacts

- The wind farm development boundary would be situated approximately 4157m to the south.
- It is anticipated that wind turbines would potentially be visible above the ridgeline and the undulating terrain.
- No turbines would be present within a 3km radius of this property.

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.



Representative Viewpoint 17

N

0 0.5km 1km 2km

Representative viewpoint location

Potential dwelling location

Expected project boundary

Ground level viewshed

220m above ground level viewshed

8km radius from dwelling

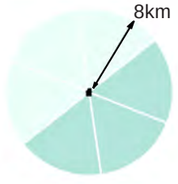
3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)



60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from properties along Head of Peel Road (UH6)
- Open view across the valley floor to the rising foothills, blanketed with mature vegetation

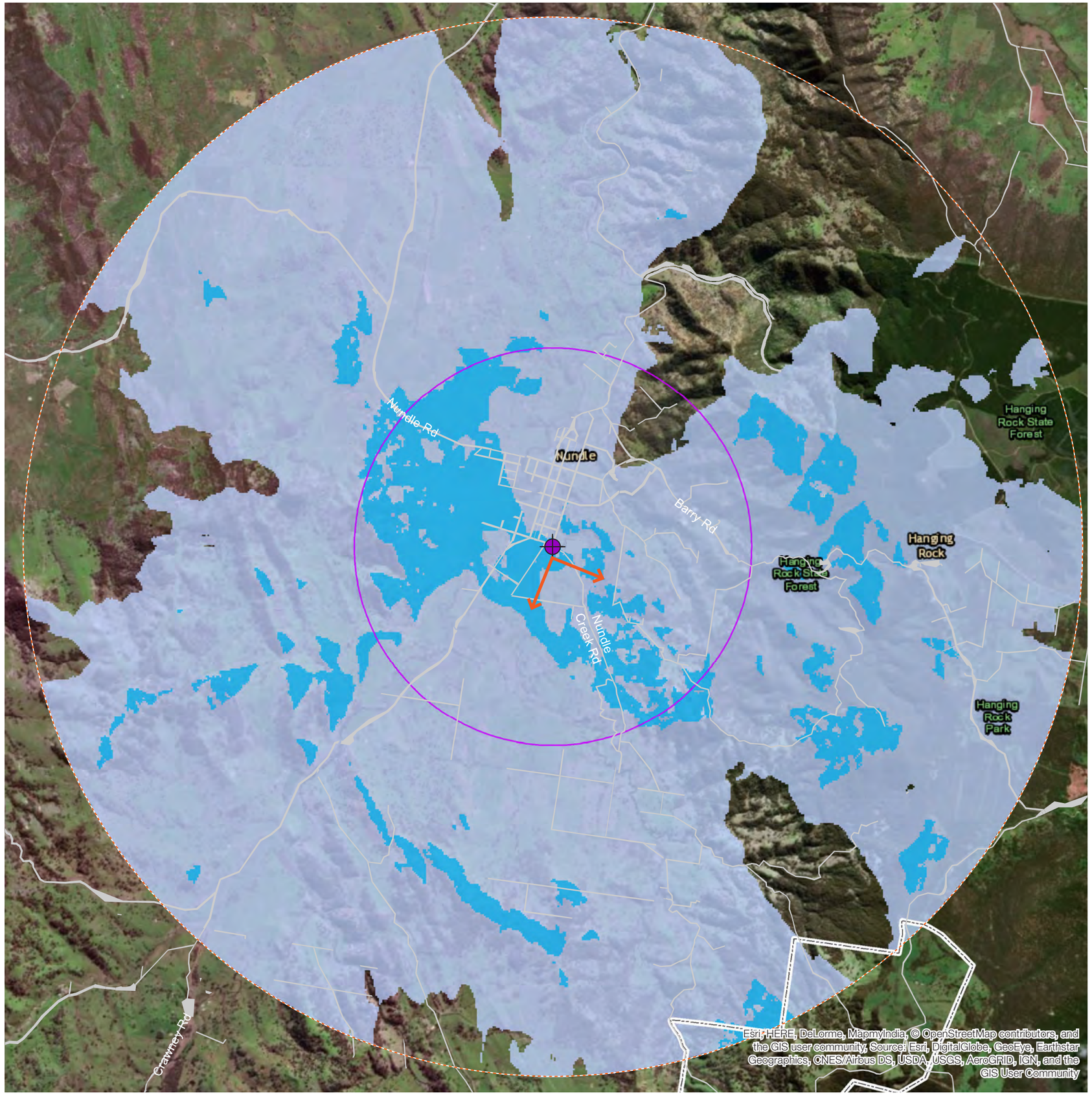
Potential impacts

- The wind farm development boundary would be situated approximately 3597m to the south west, south and east
- It is anticipated that wind turbines would potentially be visible along the ridgeline in the distance
- No turbines would be present within a 3km radius of this property

Further investigation

During the EIS stage, detailed consideration will be given to the location of substations and overhead powerlines.

Detailed assessment of the screening value of intervening vegetation through the preparation of a photomontage.



Representative Viewpoint 18

N

0 0.5km 1km 2km

- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)

60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

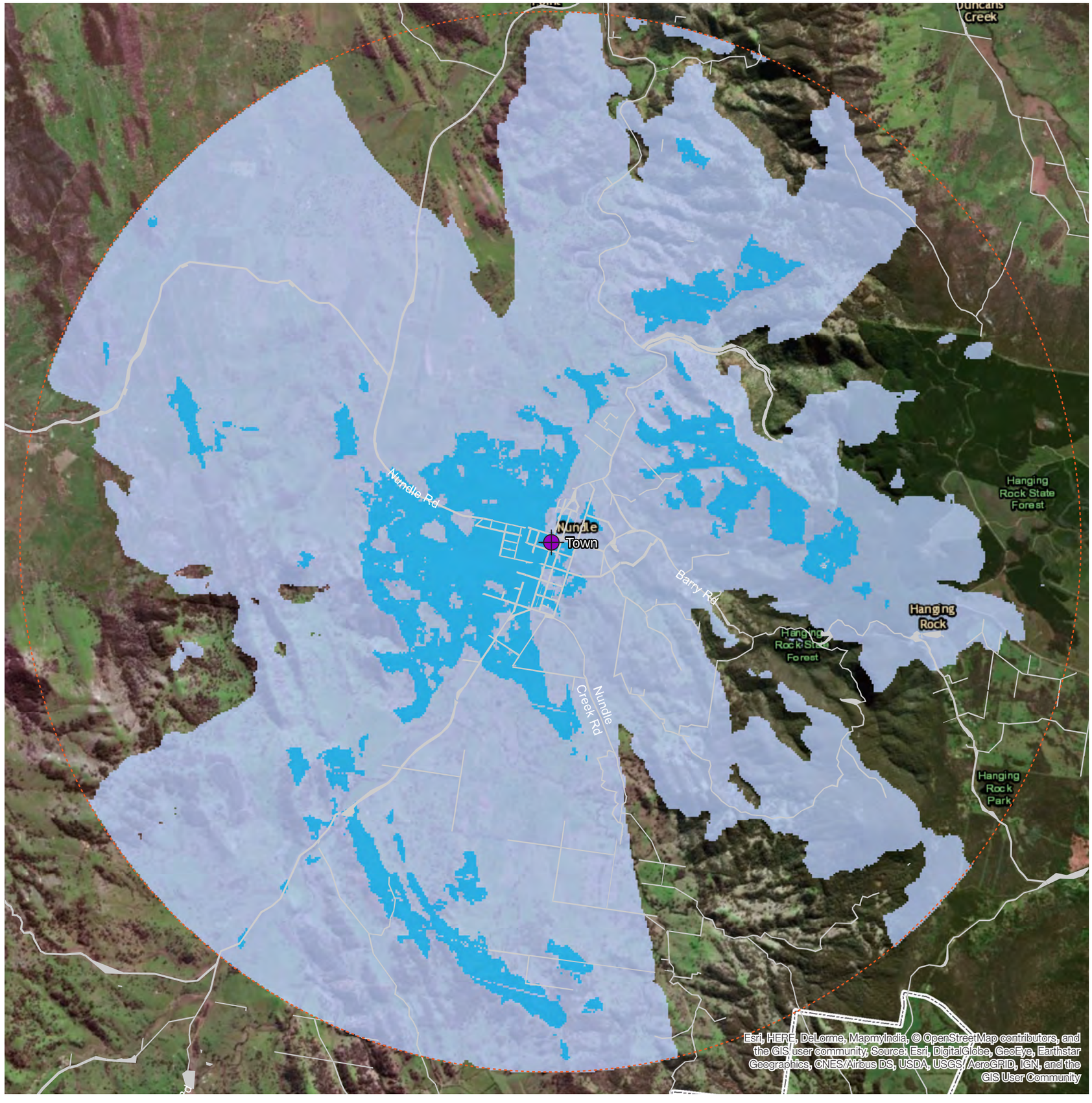
- Representative view from properties situated on the northern edge of Nundle
- View to the south across low lying agricultural parcels with intermittent trees planting lining creek line s and land parcel boundaries

Potential impacts

- The wind farm development boundary would be situated approximately 6949m to the south east
- It is anticipated that wind turbines would potentially be visible along the ridgeline in the distance
- No turbines would be present within a 3km radius of this property

Further investigation

During the EIS stage, detailed consideration the study area will be increased to fully illustrate the impact of wind turbines from Nundle town. Detailed consideration will also be given to the location of substations and overhead powerlines.



Representative Viewpoint 19

N

0 0.5km 1km 2km

- Representative viewpoint location
- Potential dwelling location
- Expected project boundary
- Ground level viewshed
- 220m above ground level viewshed
- 8km radius from dwelling
- 3km radius from dwelling

Ground level viewshed represents the current land theoretically visible.

220m above ground level viewshed represents the land where a 220m tall turbine could theoretically be visible 8km from the dwelling.

Preliminary Assessment Tool

Multiple wind turbines (Wind Energy: Visual Assessment Bulletin)

60 degree sectors in which wind turbines are potentially visible from the dwelling

Note:

This viewpoint location was selected to represent an area where views towards the wind farm development area could potentially be achievable. The view is not an accurate representation of views experienced from individual properties and has been selected to represent the worst case scenario.

Baseline visual description

- Representative view from properties situated on the northern edge of Nundle.
- View to the south across low lying agricultural parcels with intermittent trees planting lining creek lines and land parcel boundaries.

Potential impacts

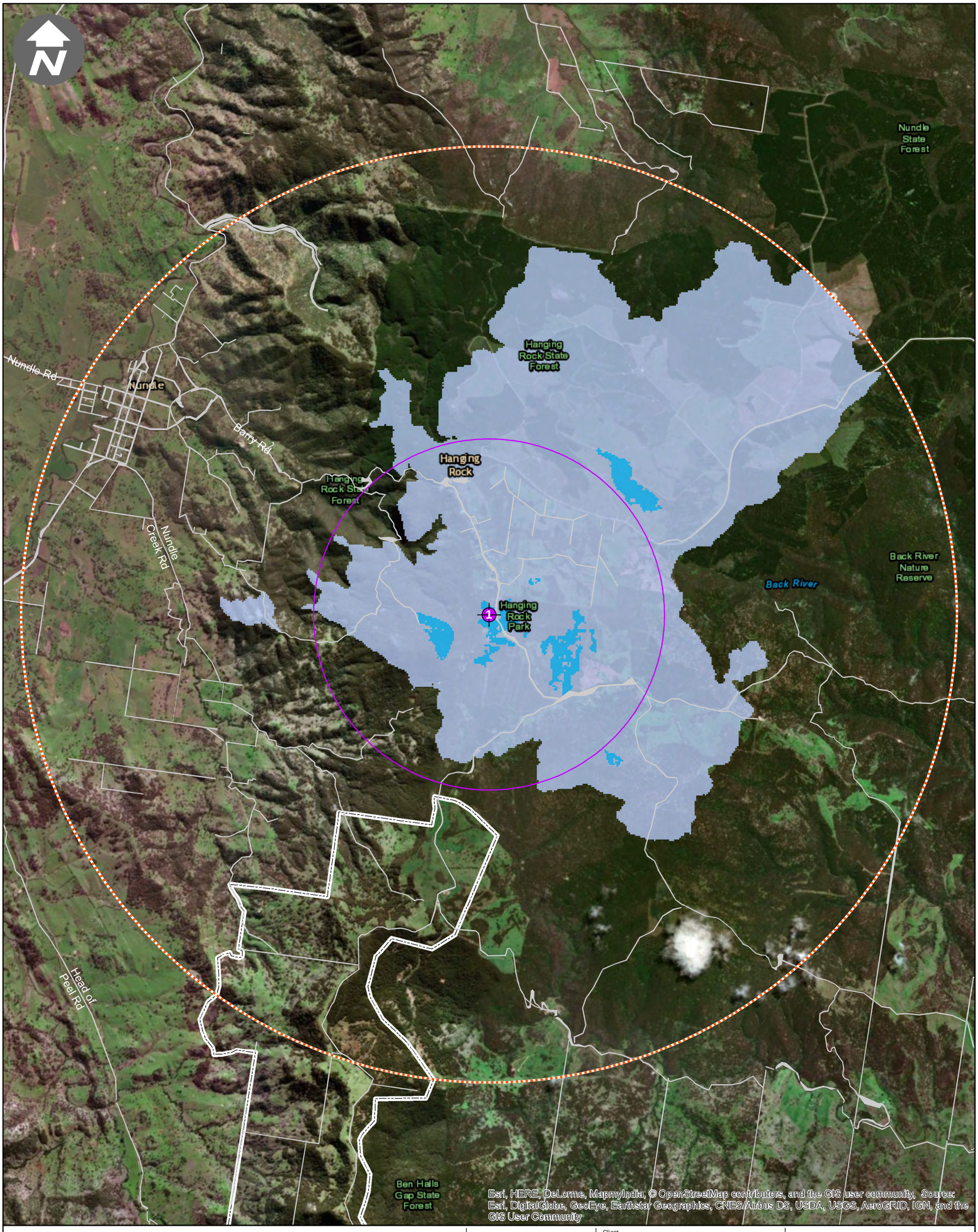
- The wind farm development boundary would be situated approximately 7955m to the north.
- No turbines would be present within a 3km radius of this location and no turbines would be visible within 8km, however there is potential for turbines to be visible along the ridgeline in the distance.

Further investigation

During the EIS stage, detailed consideration the study area will be increased to fully illustrate the impact of wind turbines from Nundle town. Detailed consideration will also be given to the location of substations and overhead powerlines.

06

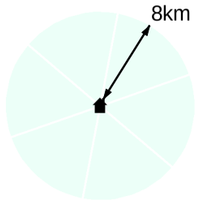
Appendix A



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3226m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 1

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

ARUP
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Fortitude Valley, QLD 4006
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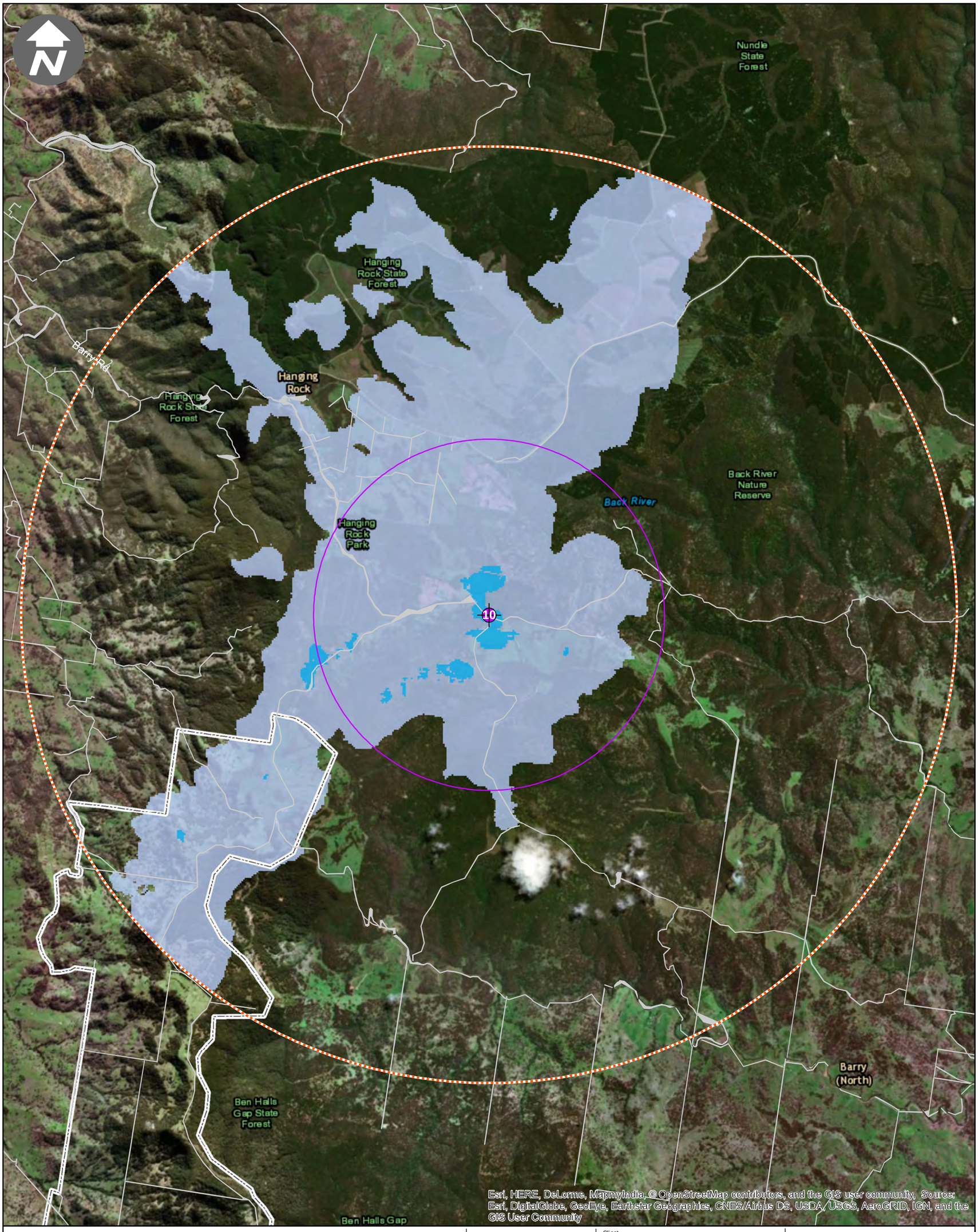
www.arup.com

Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

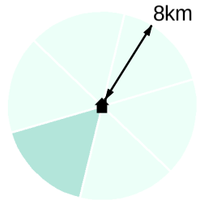
Job No	Figure No
602173-79	**NWF-1**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3455m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 10

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

ARUP
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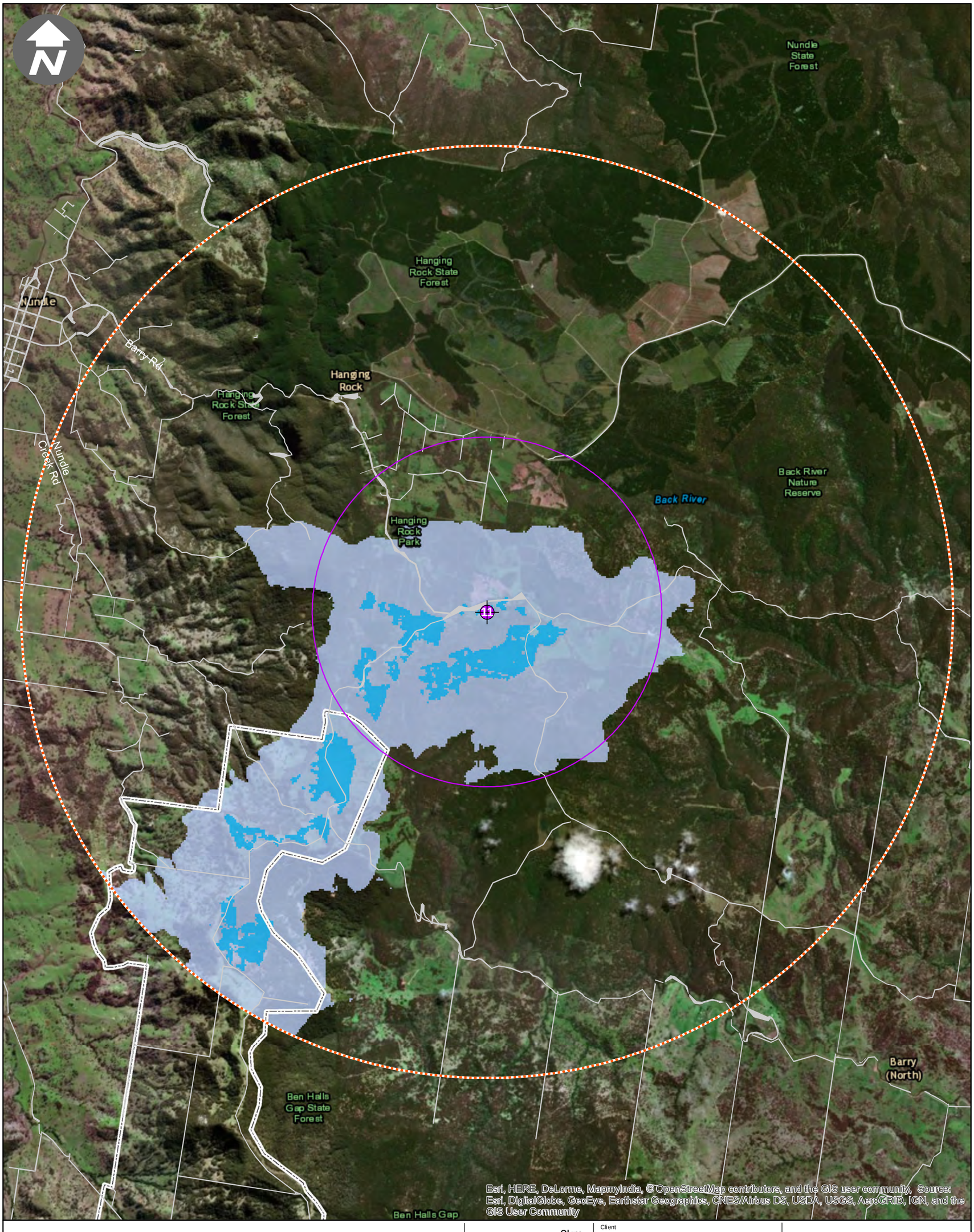
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

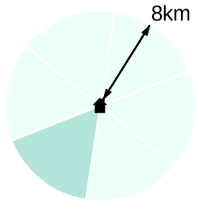
Job No	Figure No
602173-79	**NWF-10**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 2789m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 11**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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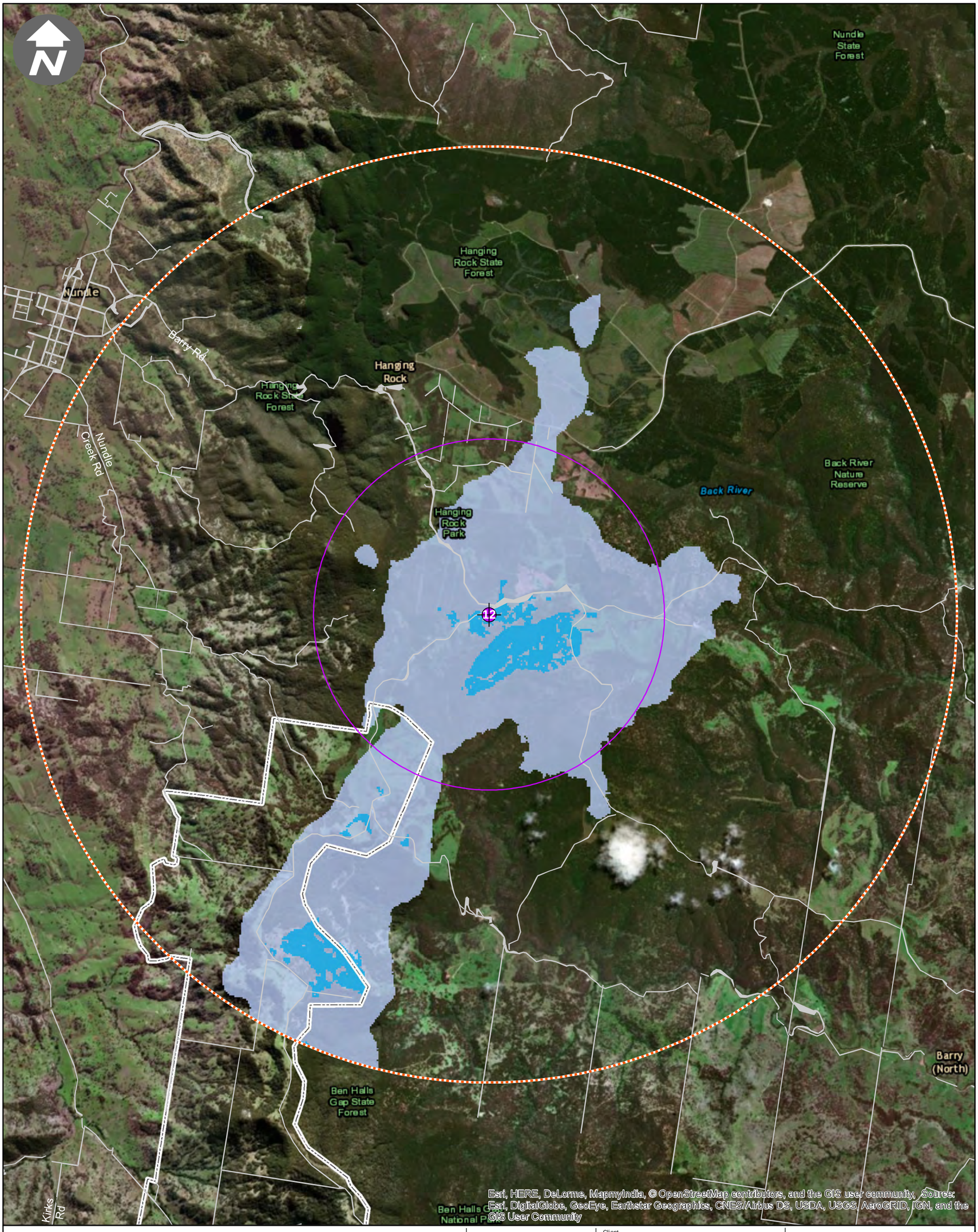
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

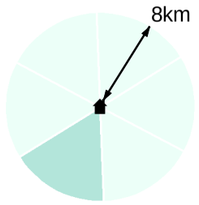
Job No	Figure No
602173-79	NWF-11



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 2220m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 12**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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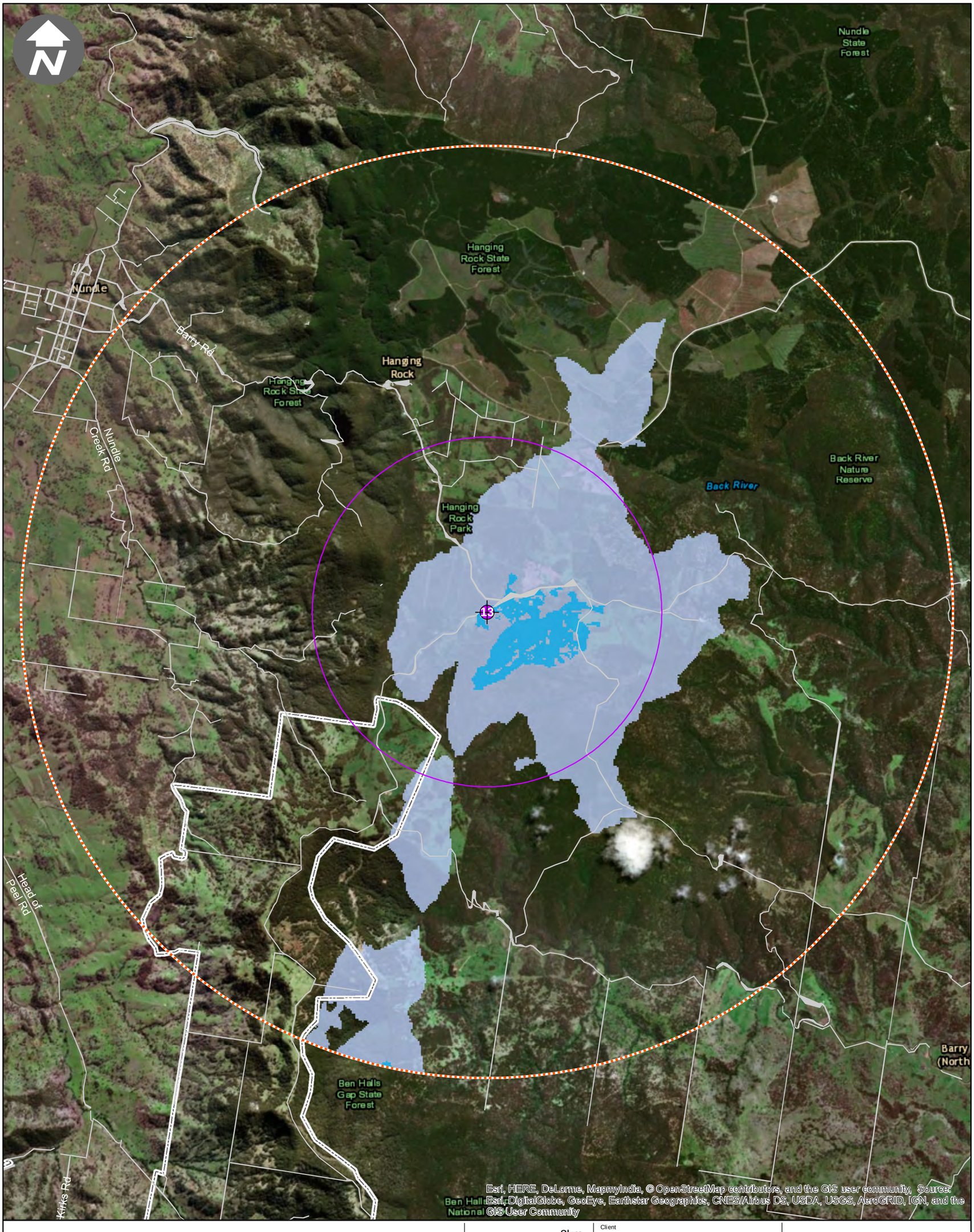
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

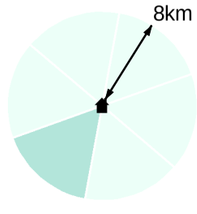
Job No	Figure No
602173-79	NWF-12



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 2107m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 13**

Metres: 0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

ARUP

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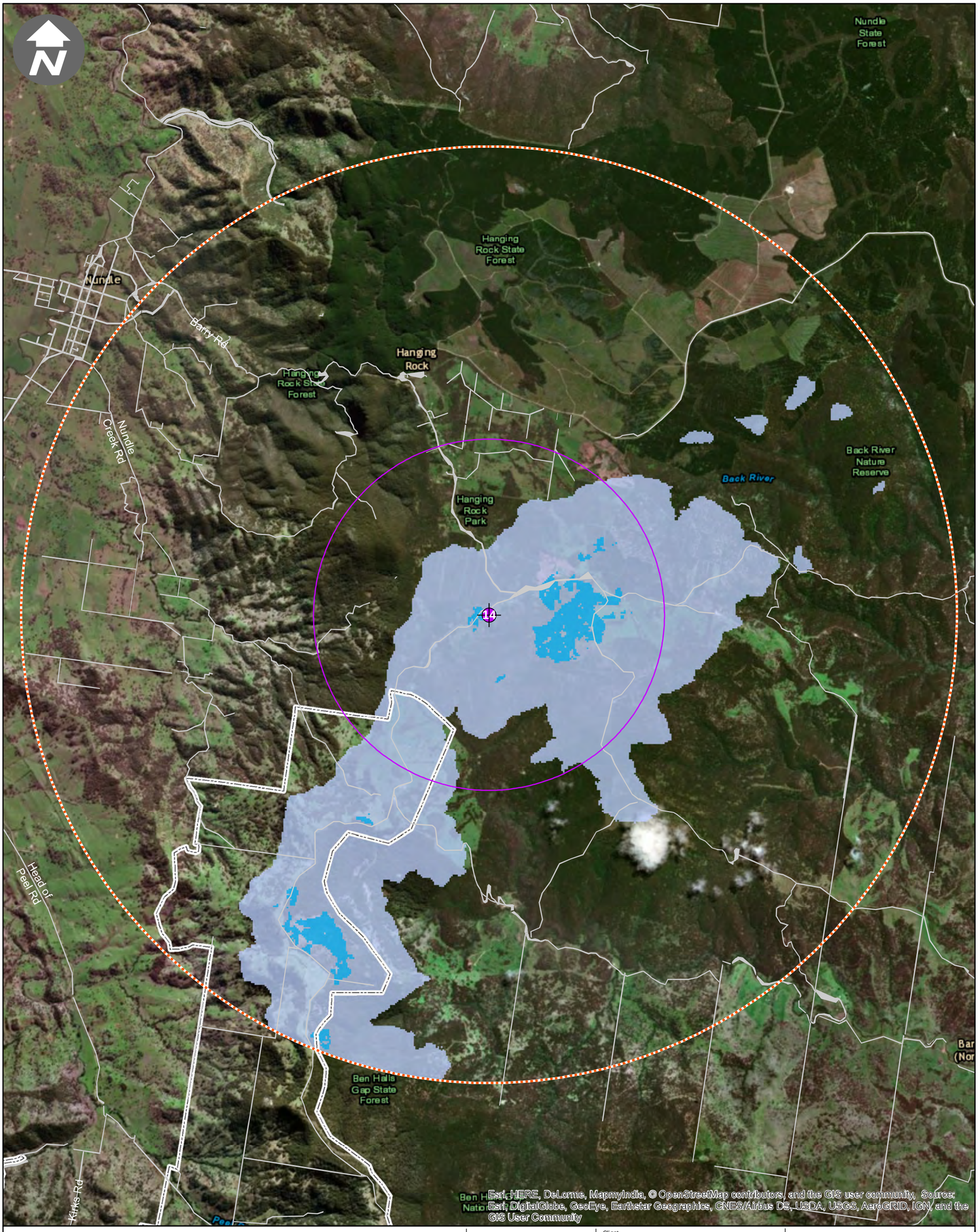
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

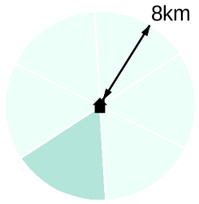
Job No	Figure No
602173-79	NWF-13



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1857m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 14**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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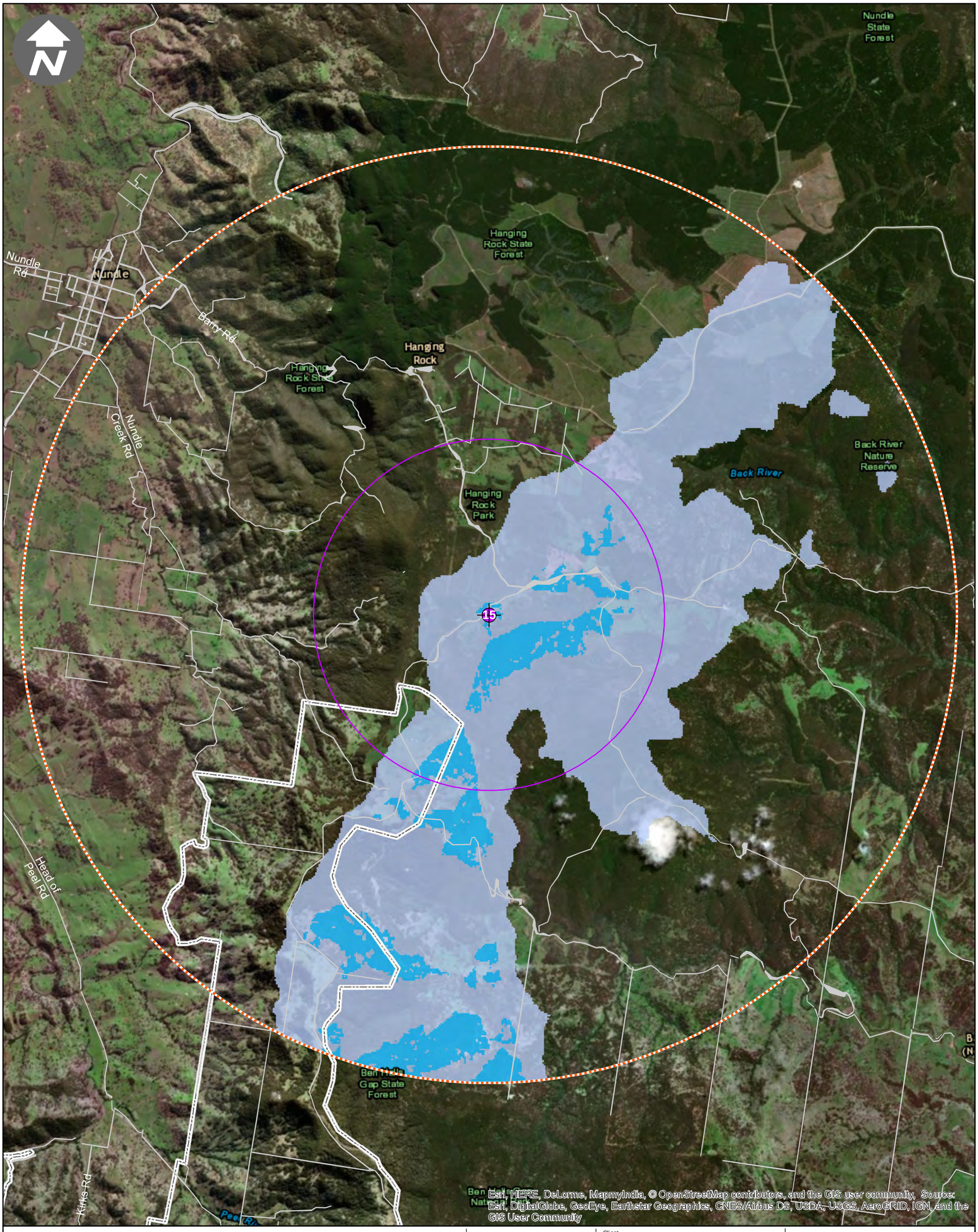
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

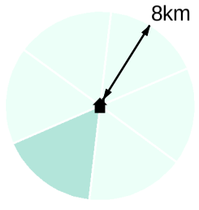
Job No	Figure No
602173-79	NWF-14



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1699m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 15

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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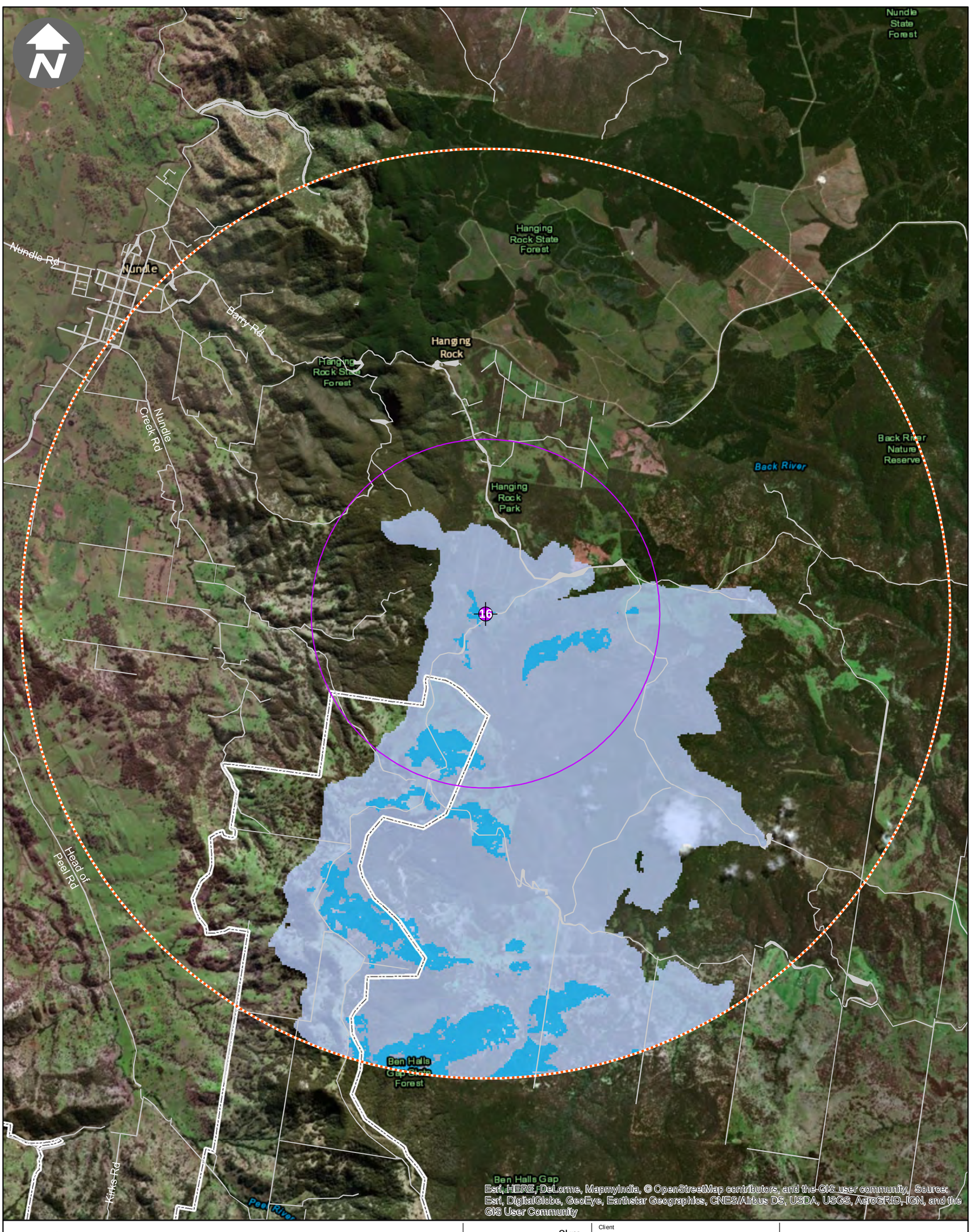
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

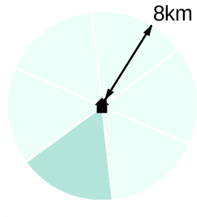
Job No	Figure No
602173-79	**NWF-15**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1336m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 16**

Metres: 0 500 1,000 1,500 2,000

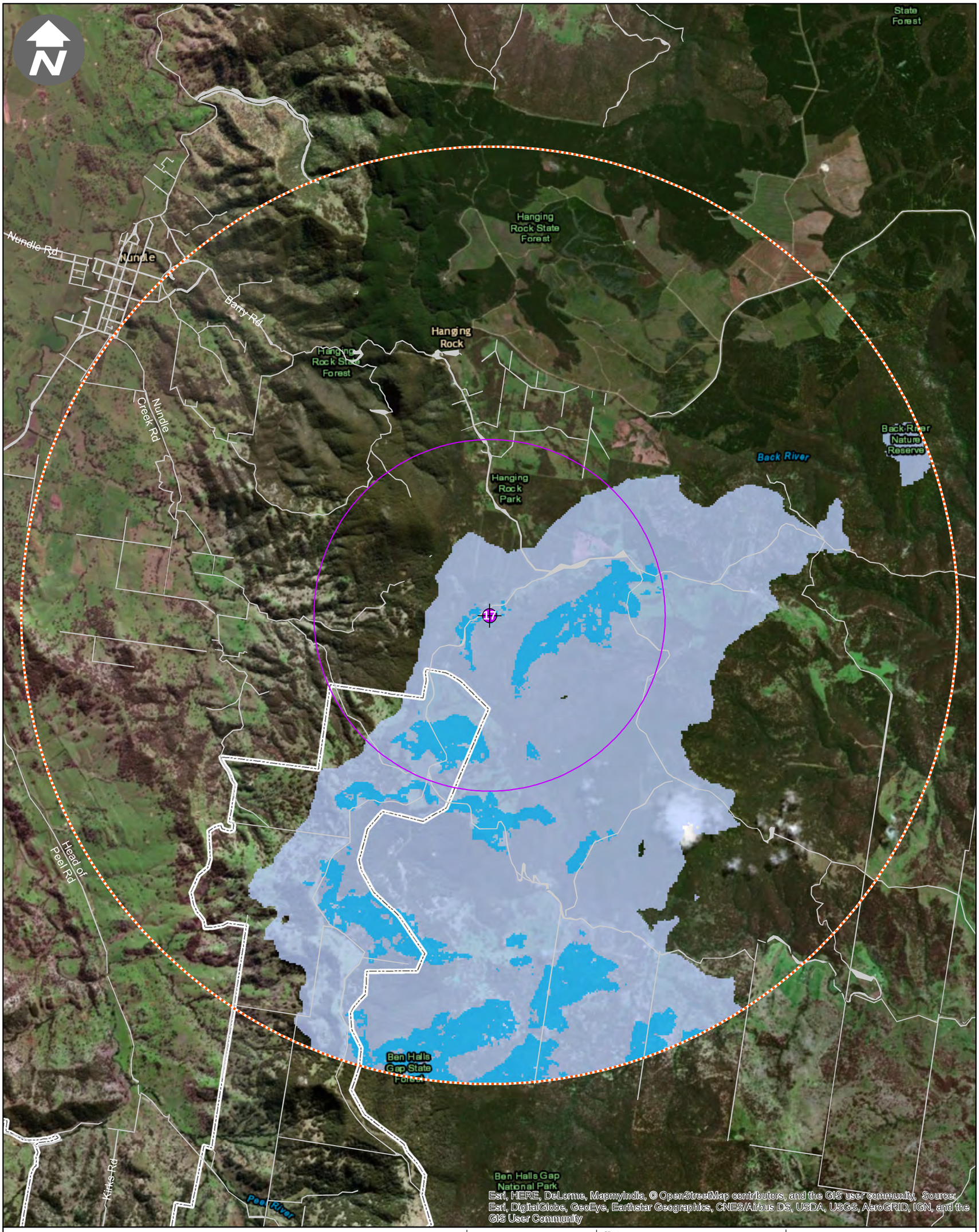
Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

ARUP
Level 4, 108 Wickham Street
Fortitude Valley, QLD 4006
Tel +61 (7)3023 6000 Fax +61 (7)3023 6023
www.arup.com

Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

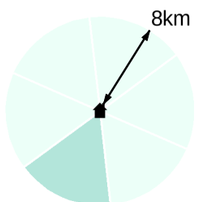
Job No	Figure No
602173-79	NWF-16



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1221m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 17**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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Fortitude Valley, QLD 4006
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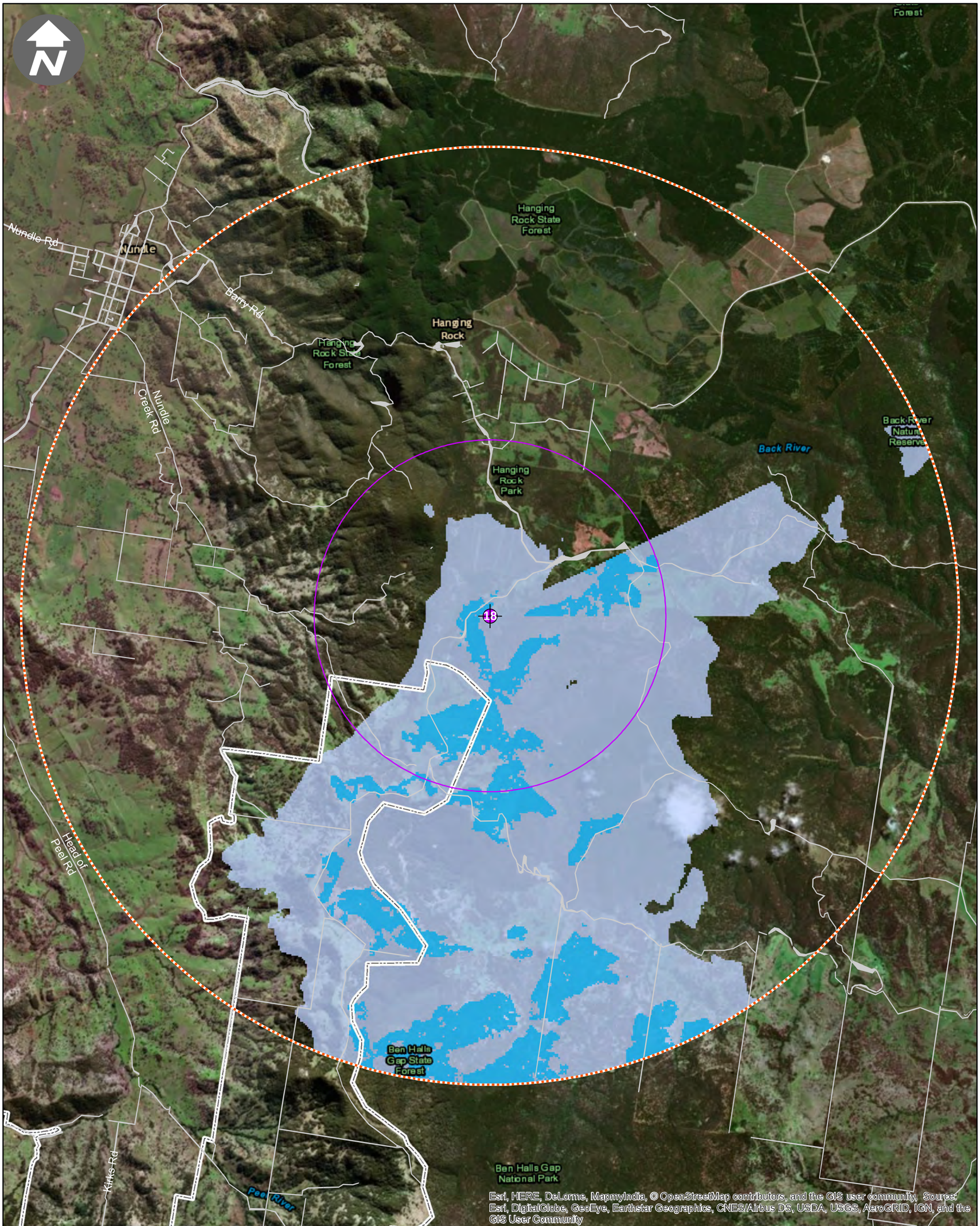
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

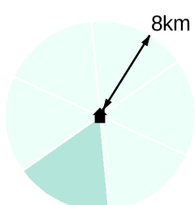
Job No	Figure No
602173-79	NWF-17



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1094m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 18

Metres
0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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Fortitude Valley, QLD 4006
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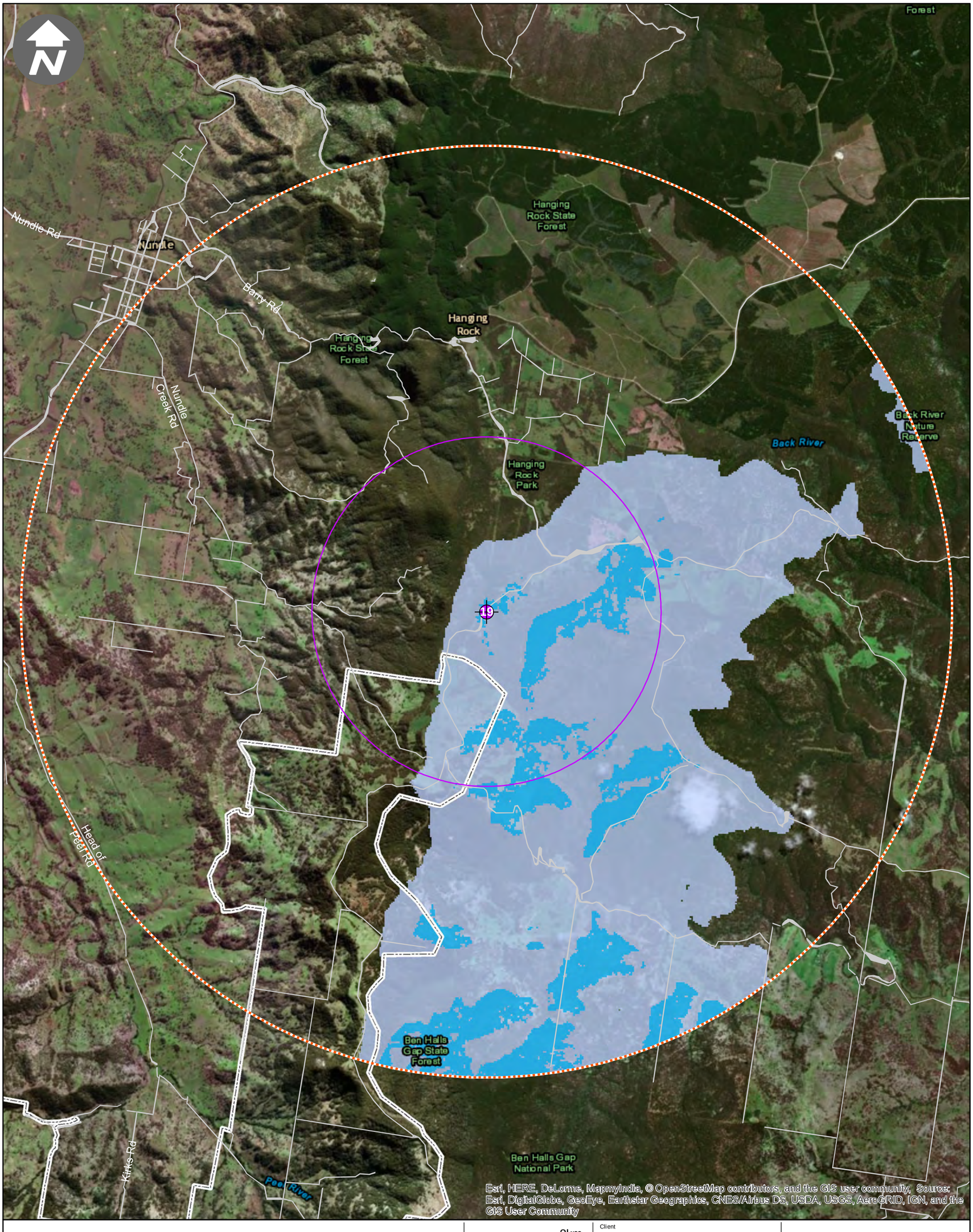
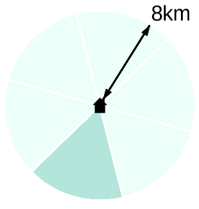
Scale at A3	Figure Status
1:60,000	**Issue**
Coordinate System	
GDA 1994 MGA Zone 56	
Job No	Figure No
602173-79	**NWF-18**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 896m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 19

Metres
0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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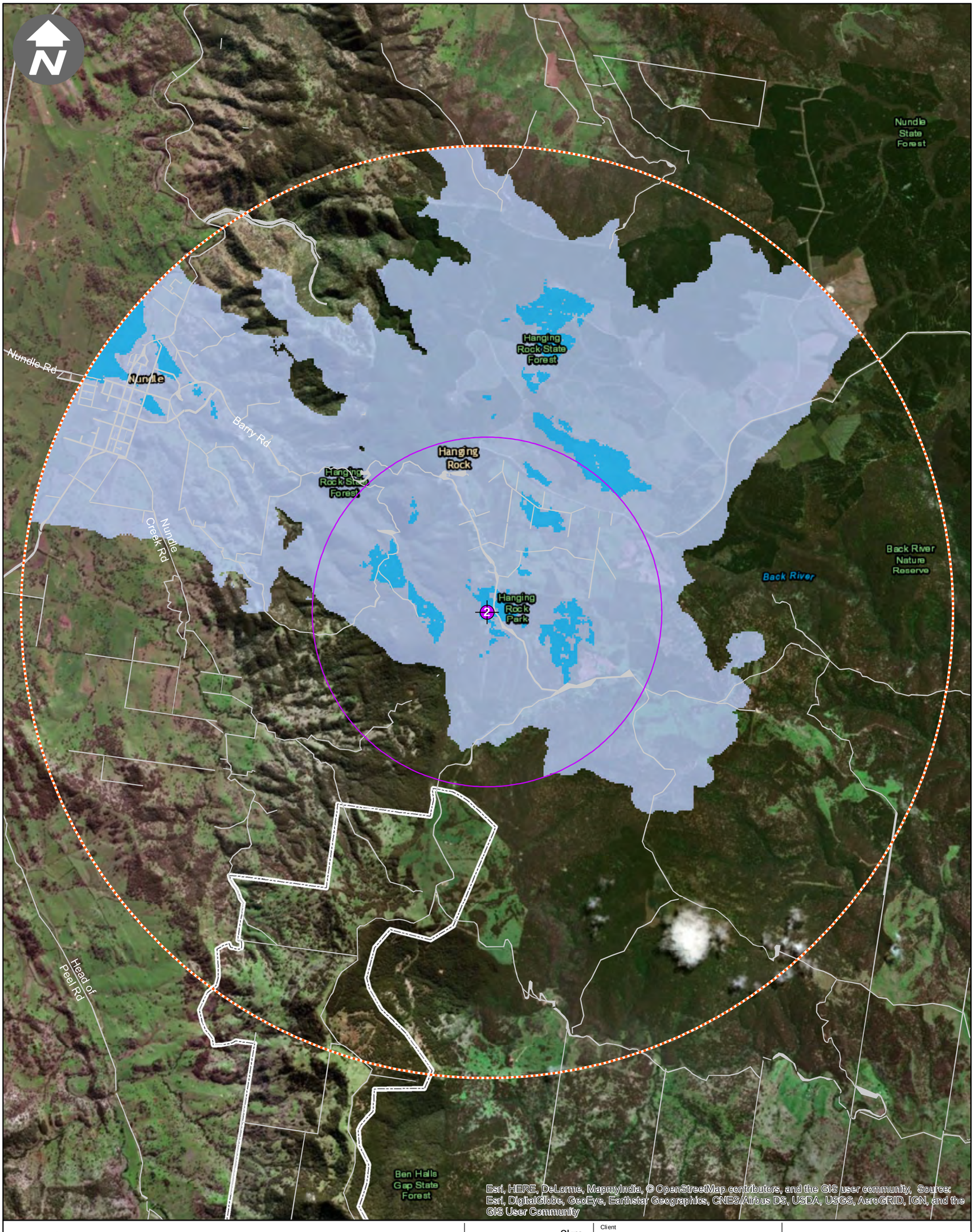
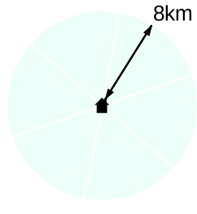
Scale at A3	Figure Status
1:60,000	**Issue**
Coordinate System	
GDA 1994 MGA Zone 56	
Job No	Figure No
602173-79	**NWF-19**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3141m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 2

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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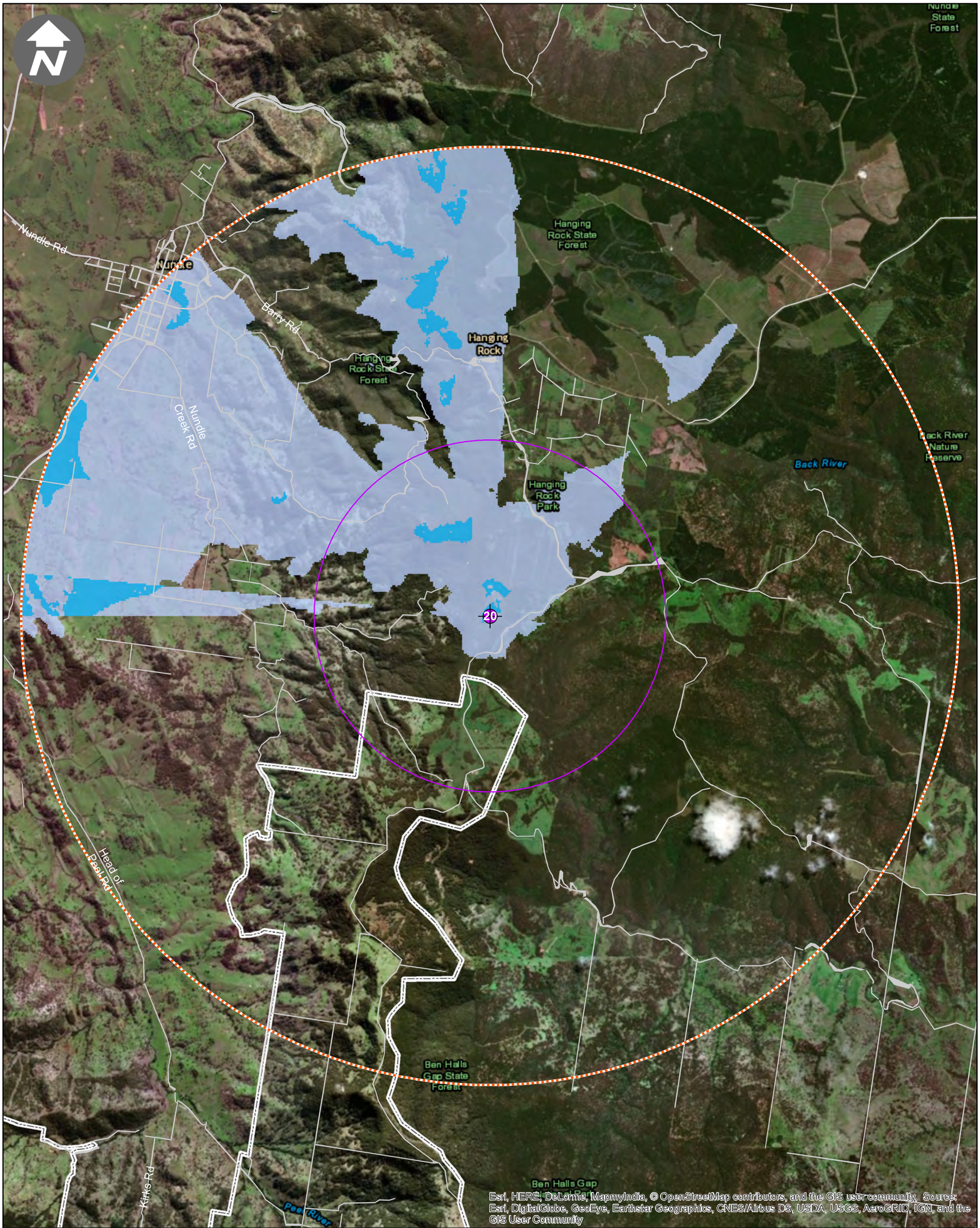
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System
GDA 1994 MGA Zone 56

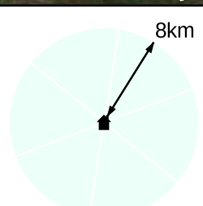
Job No	Figure No
602173-79	NWF-2



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1101m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 20**

Metres: 0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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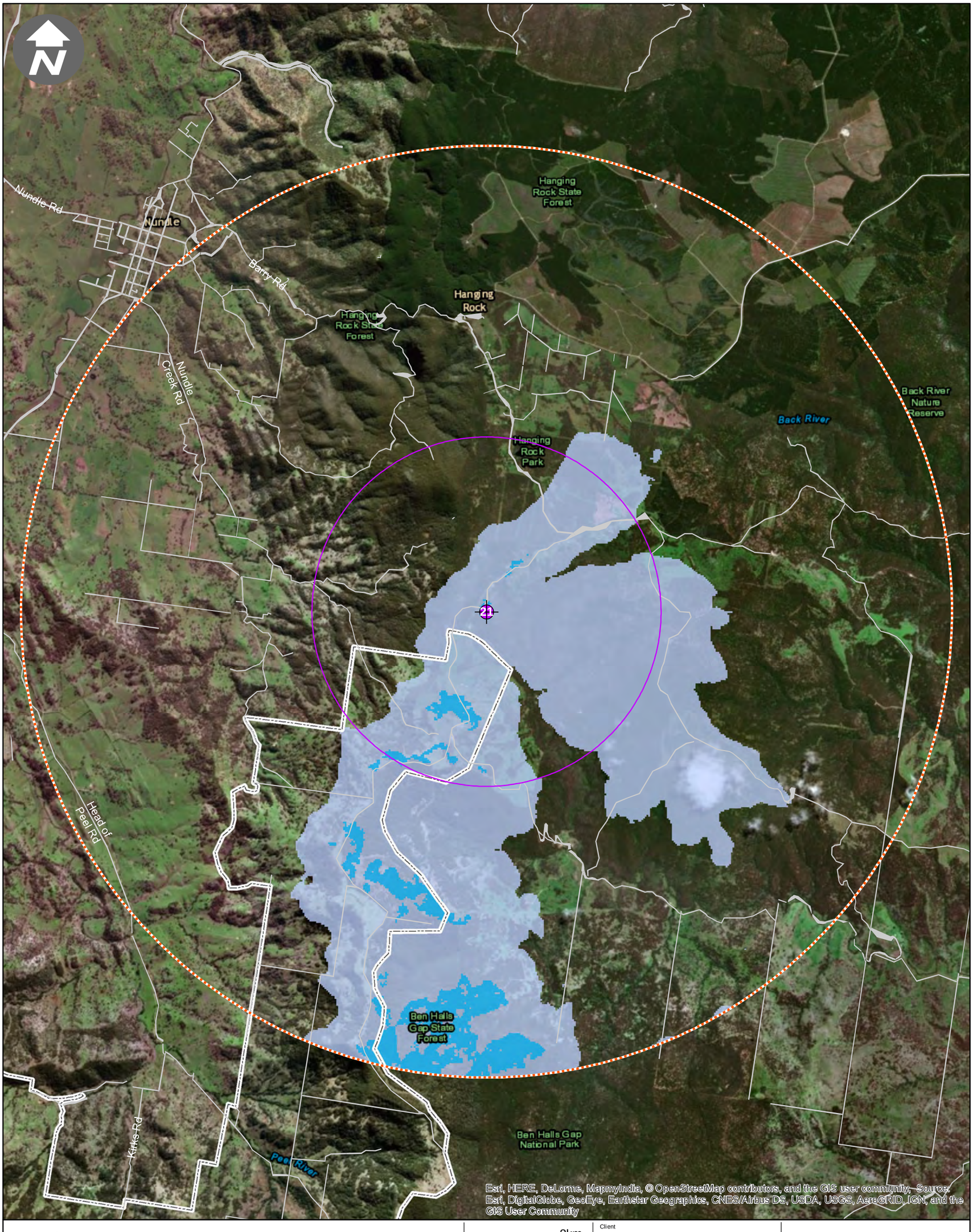
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

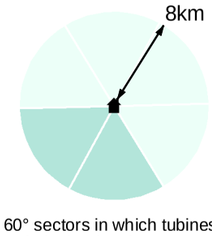
Job No	Figure No
602173-79	NWF-20



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 488m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 21

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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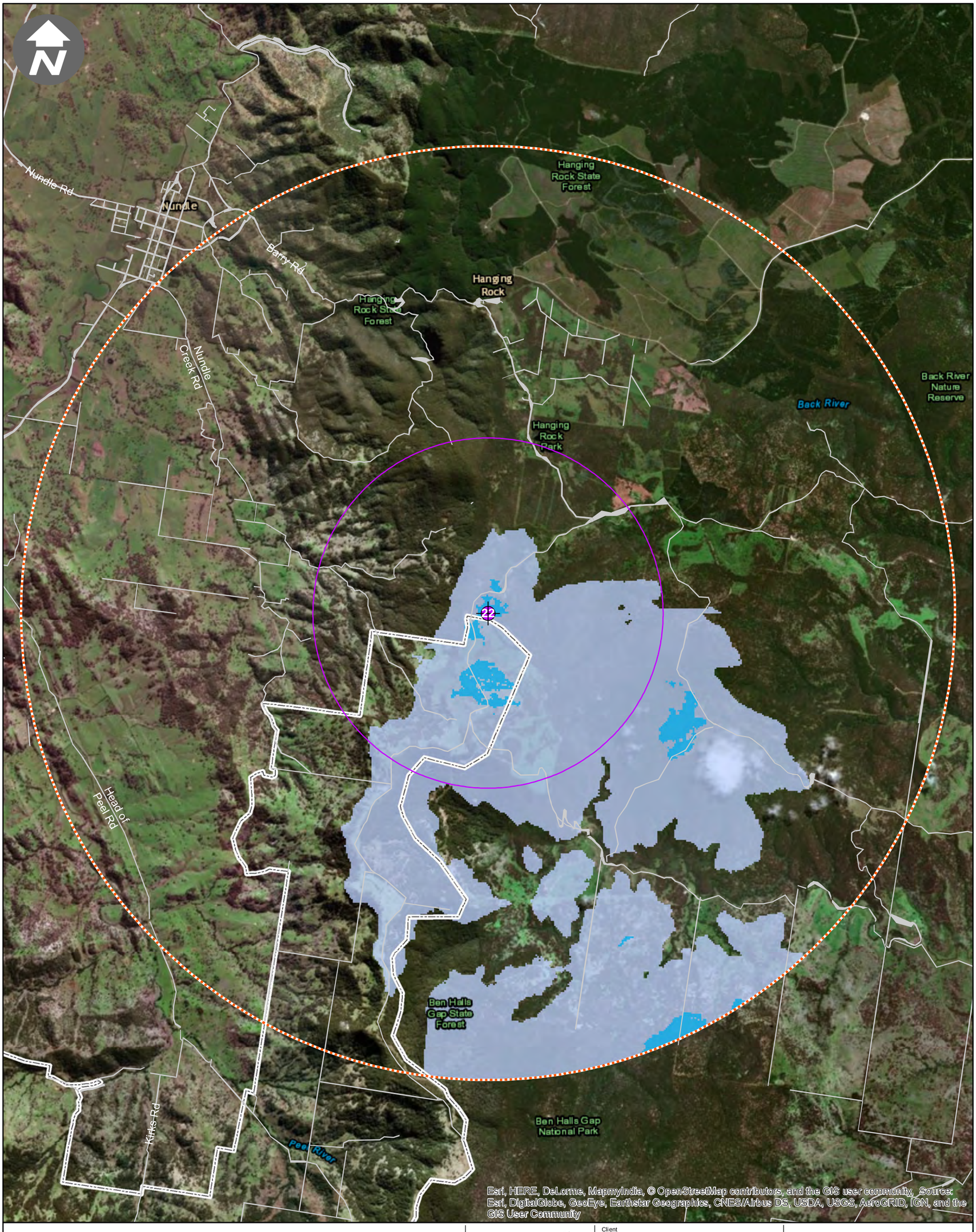
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

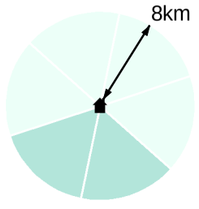
Job No	Figure No
602173-79	**NWF-21**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 114m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 22

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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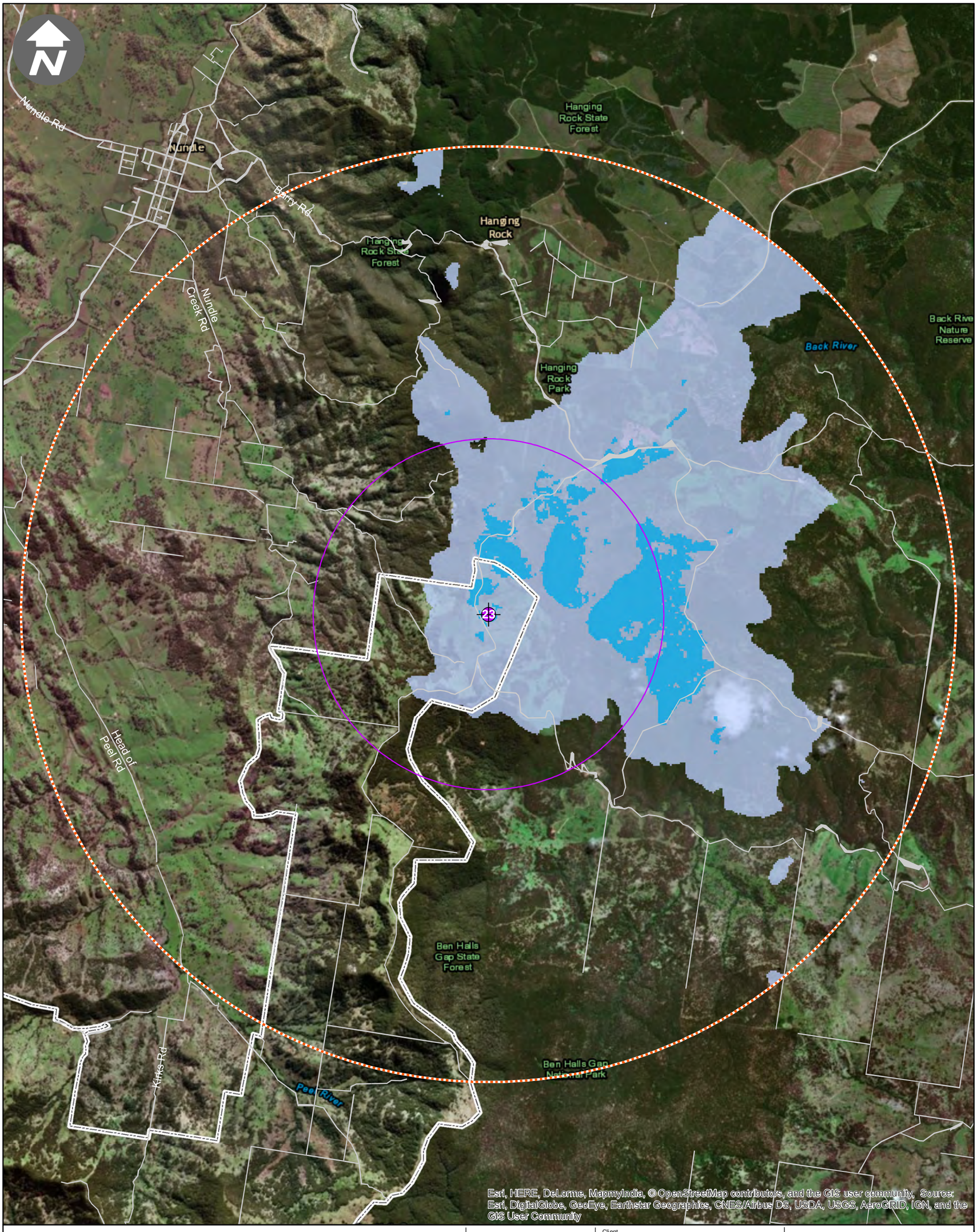
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

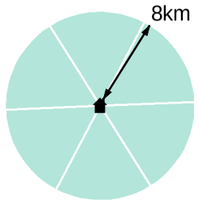
Job No	Figure No
602173-79	**NWF-22**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 544m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 23

Metres
0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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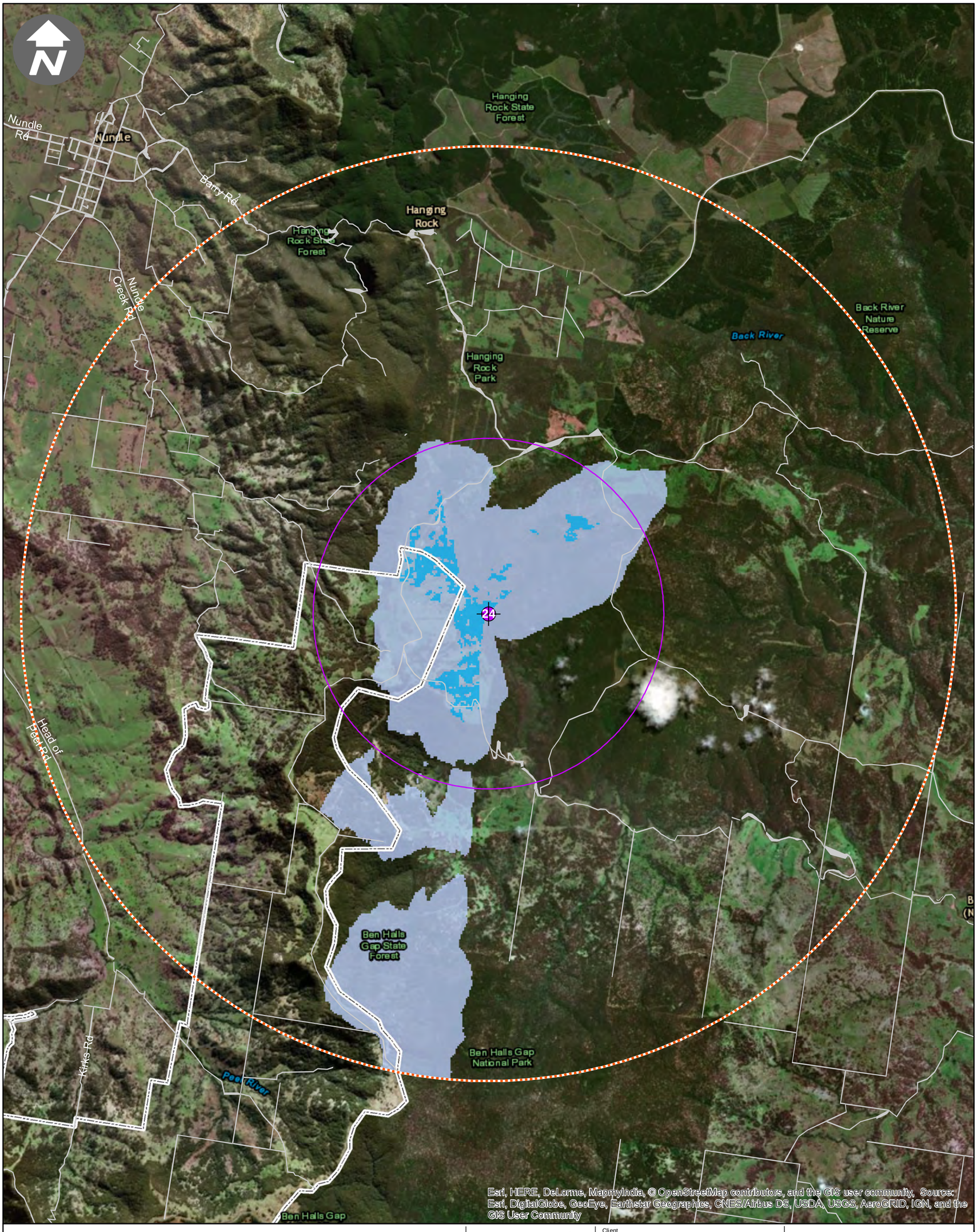
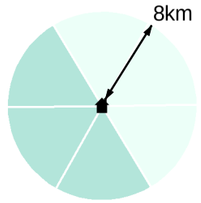
Scale at A3	Figure Status
1:60,000	**Issue**
Coordinate System	
GDA 1994 MGA Zone 56	
Job No	Figure No
602173-79	**NWF-23**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 154m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 24

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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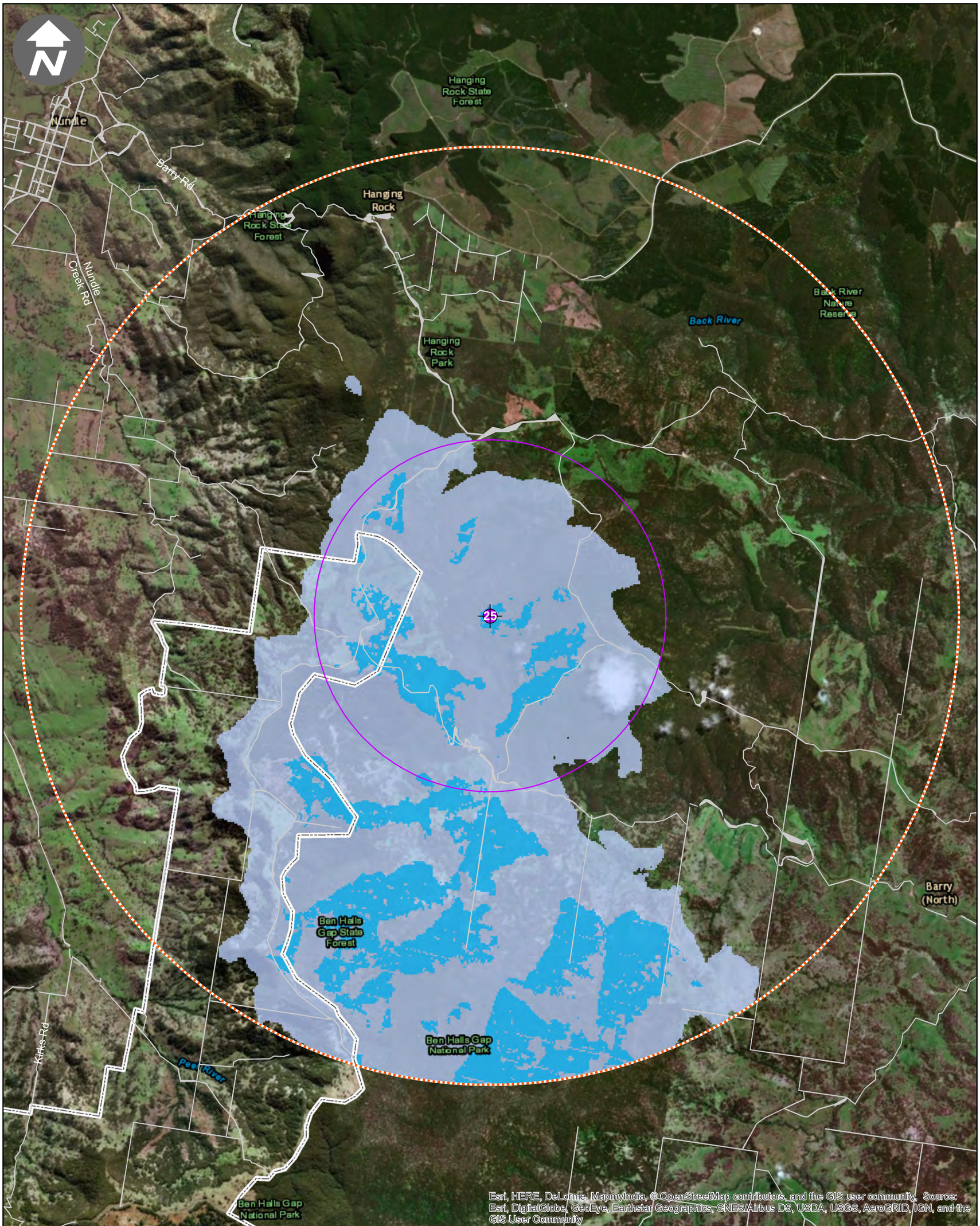
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

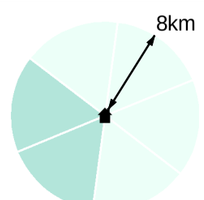
Job No	Figure No
602173-79	**NWF-24**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 864m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 25

Metres
0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

ARUP
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Fortitude Valley, QLD 4006
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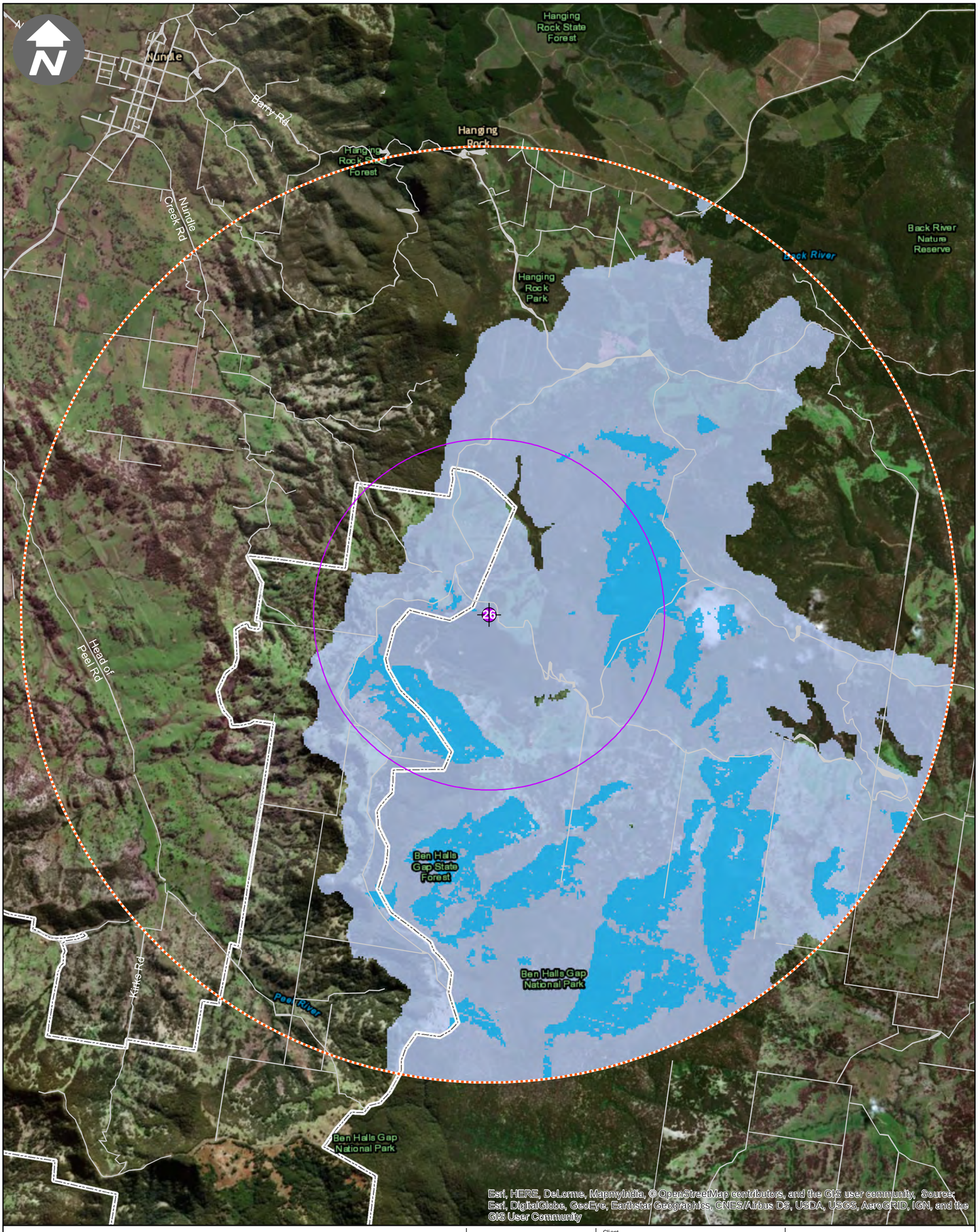
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System
GDA 1994 MGA Zone 56

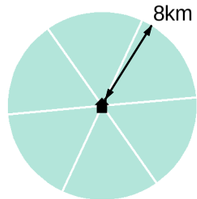
Job No	Figure No
602173-79	NWF-25



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 165m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 26

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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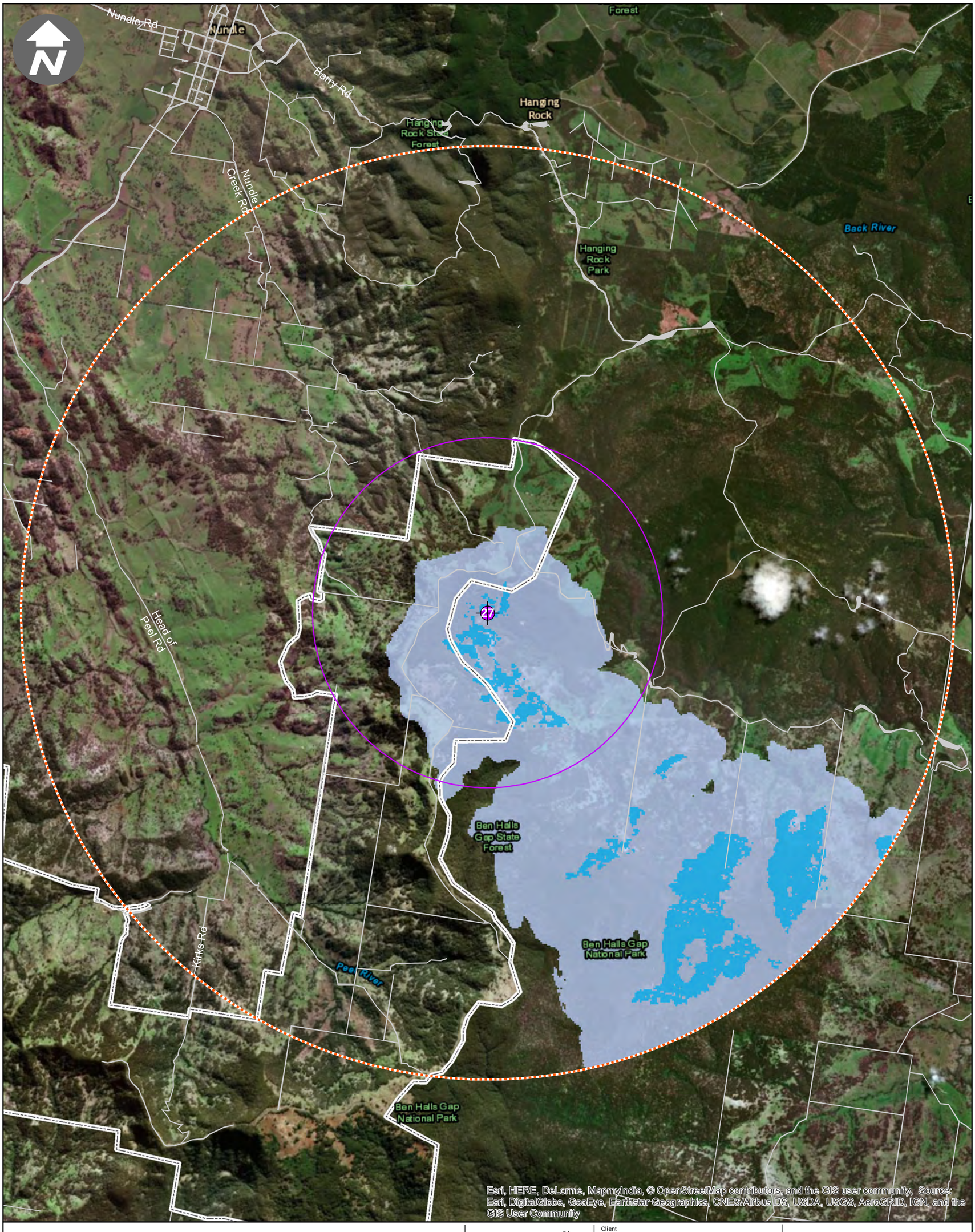
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System
GDA 1994 MGA Zone 56

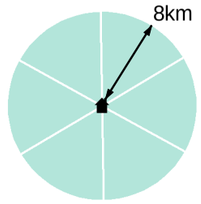
Job No	Figure No
602173-79	NWF-26



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 256m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 27

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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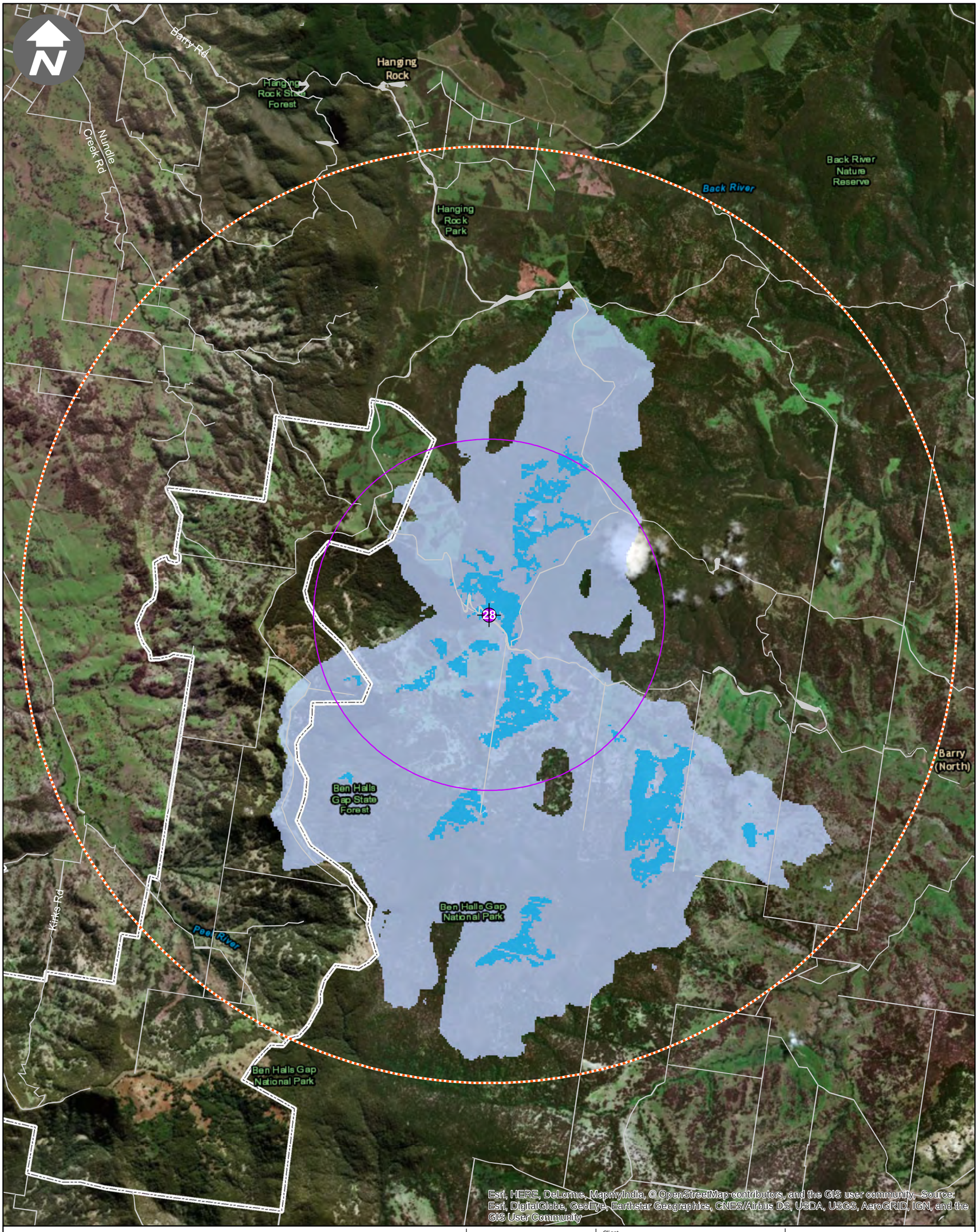
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

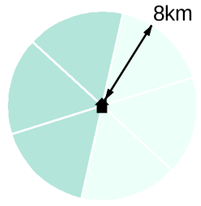
Job No	Figure No
602173-79	**NWF-27**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 781m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 28**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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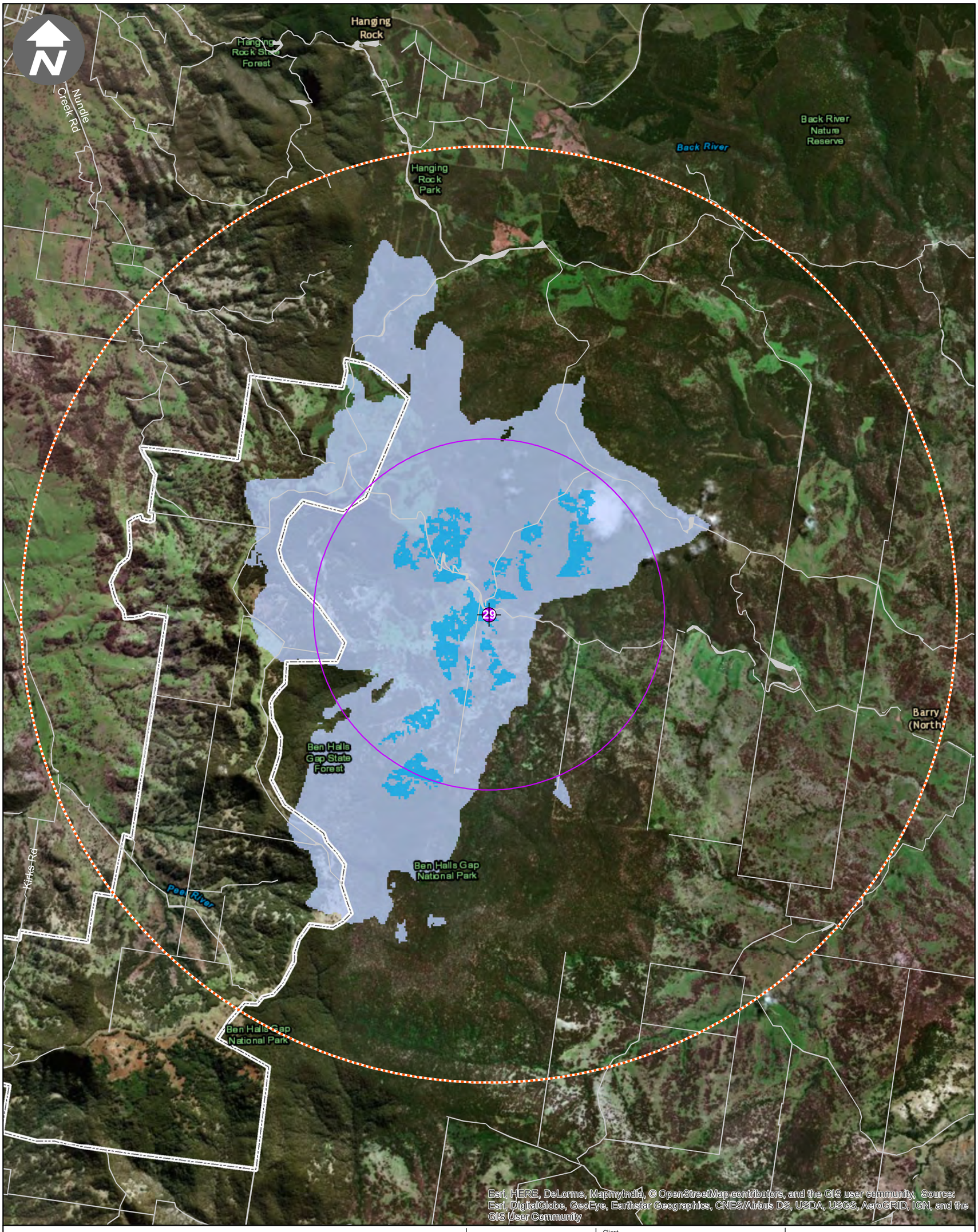
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

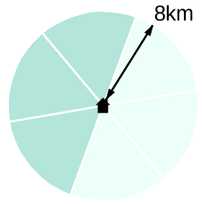
Job No	Figure No
602173-79	NWF-28



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1593m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 29**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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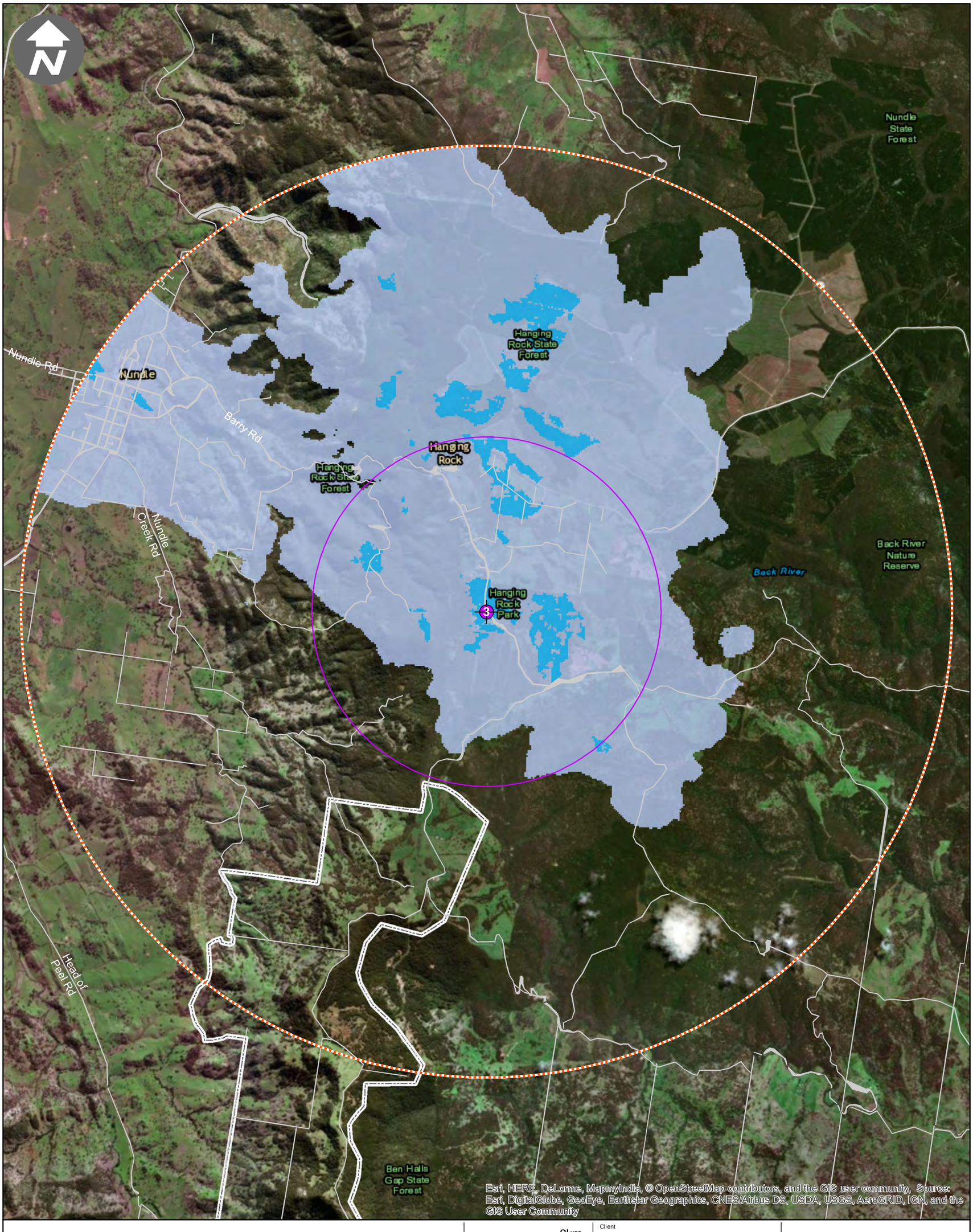
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System: **GDA 1994 MGA Zone 56**

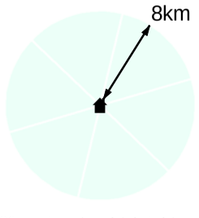
Job No	Figure No
602173-79	**NWF-29**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3096m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 3**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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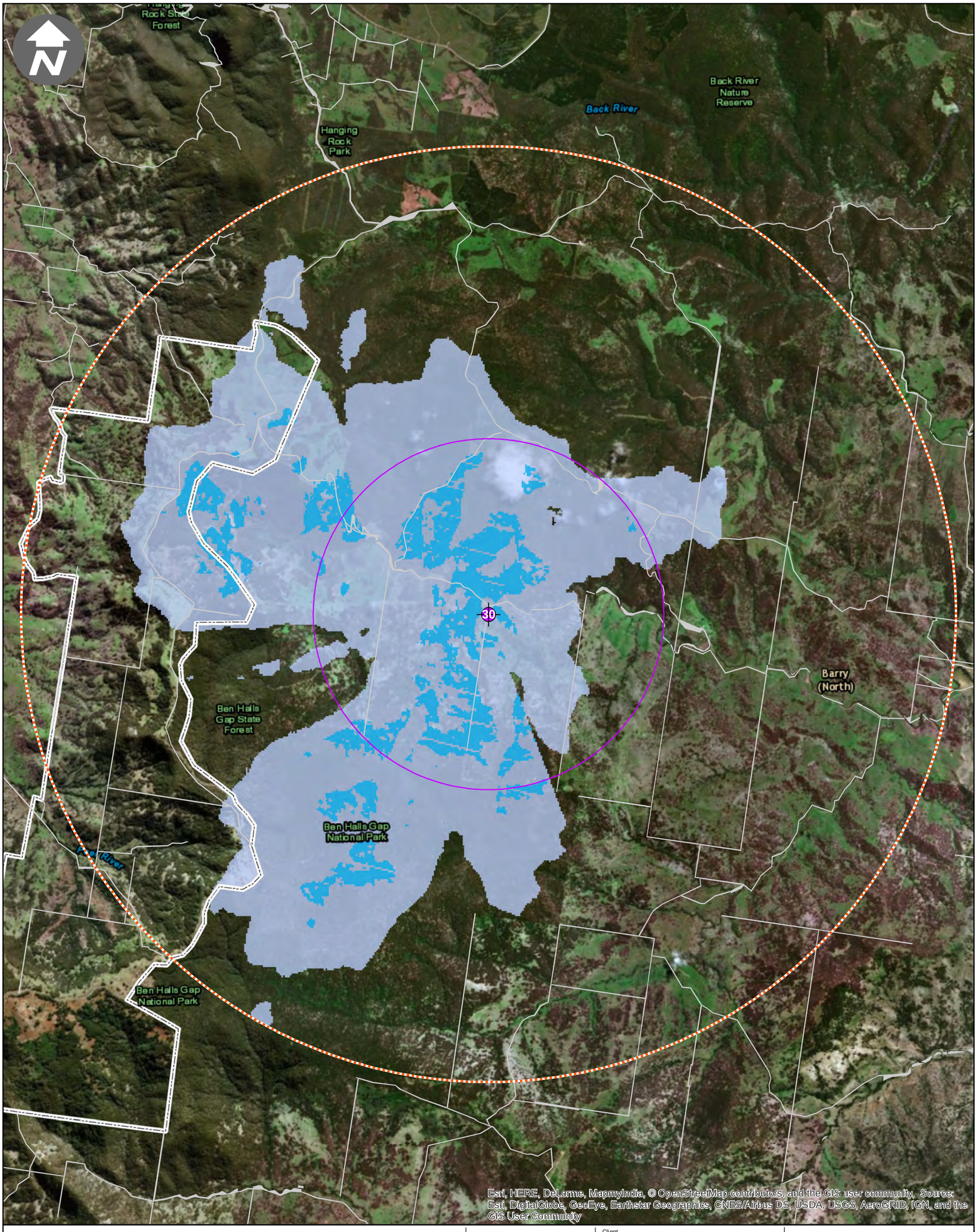
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

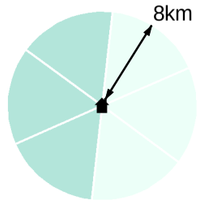
Job No	Figure No
602173-79	NWF-3



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3172m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 30

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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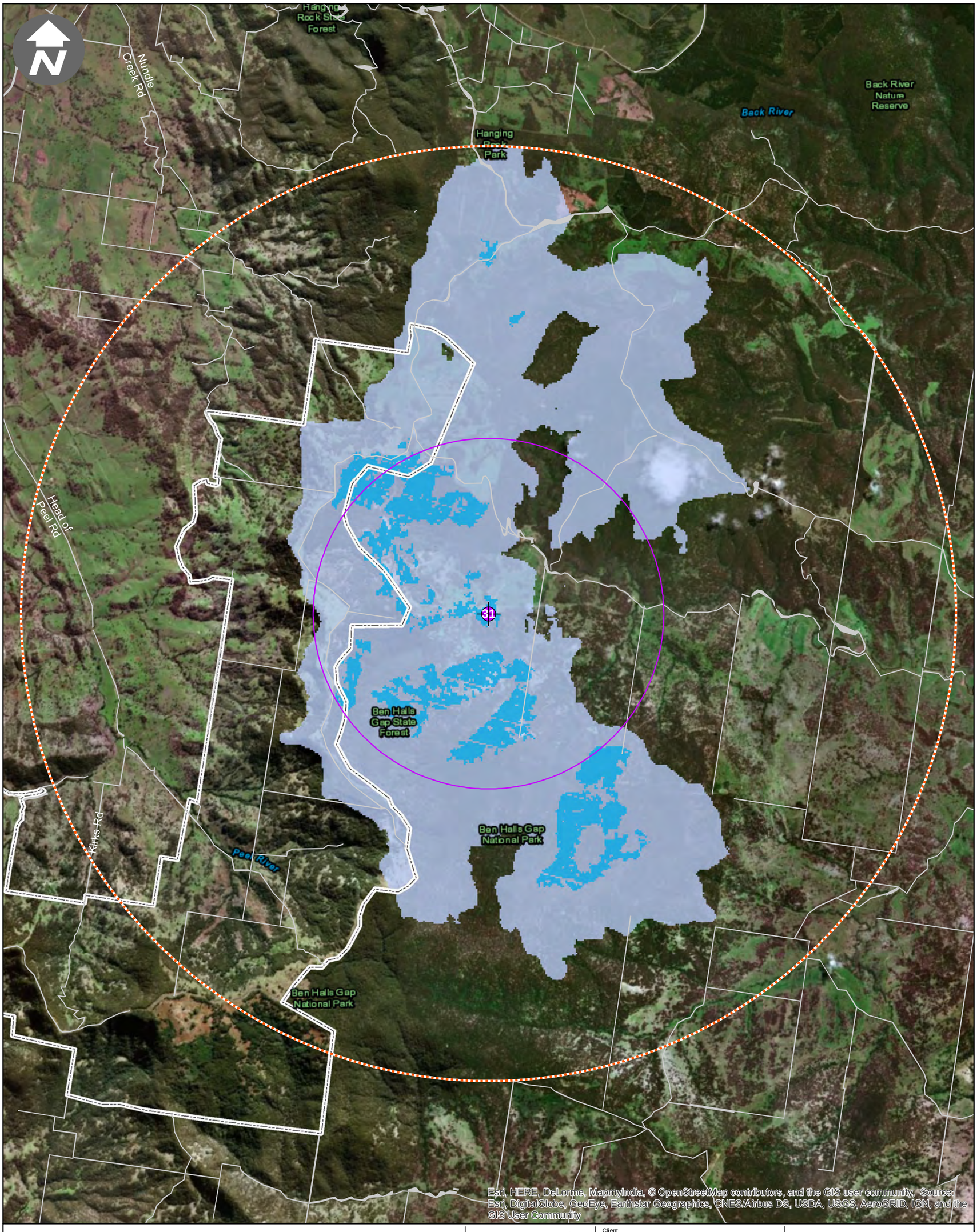
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

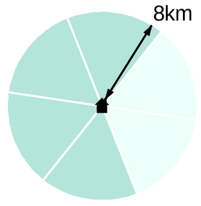
Job No	Figure No
602173-79	**NWF-30**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 785m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 31

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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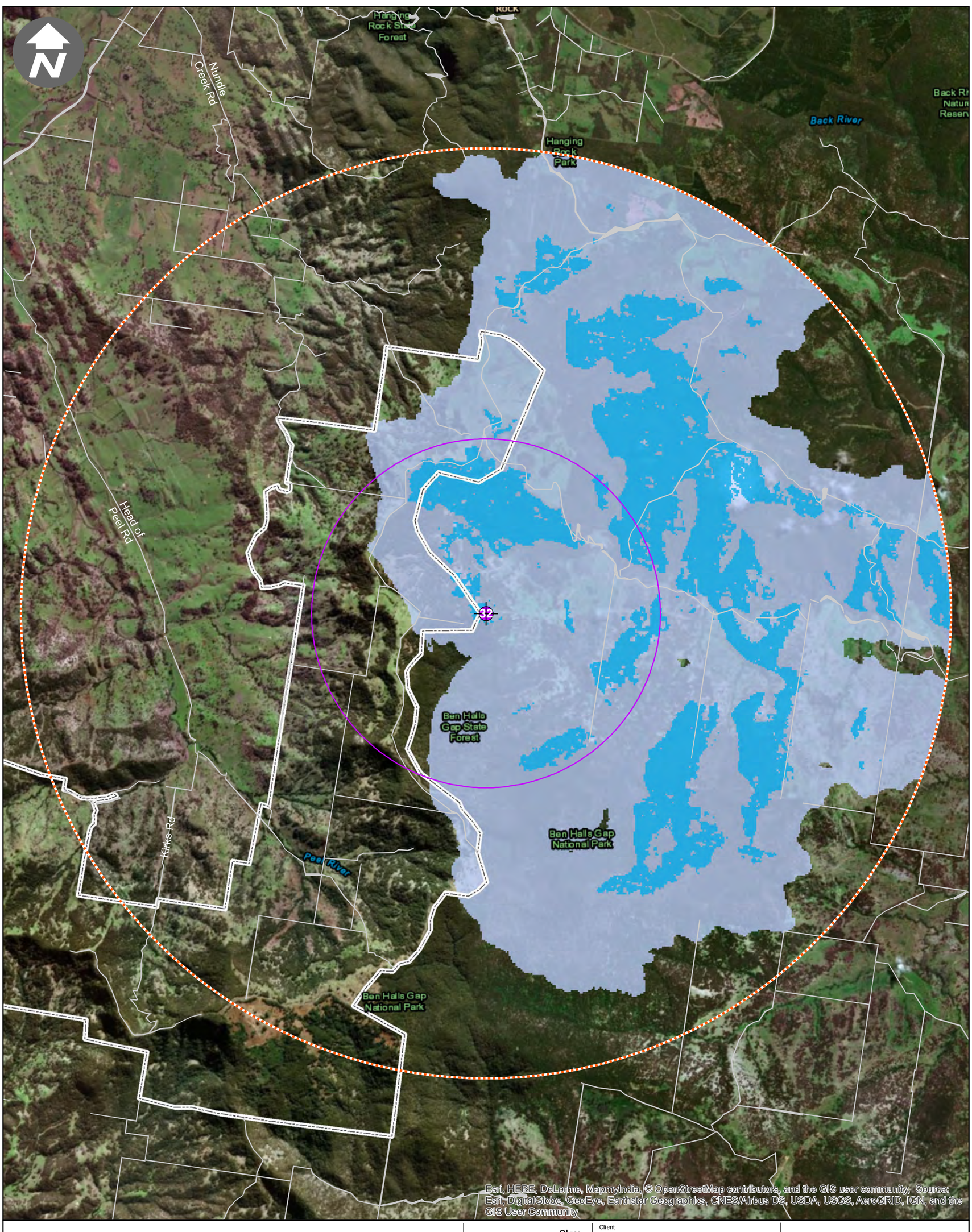
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

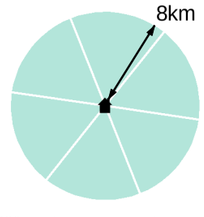
Job No	Figure No
602173-79	**NWF-31**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 463m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 32

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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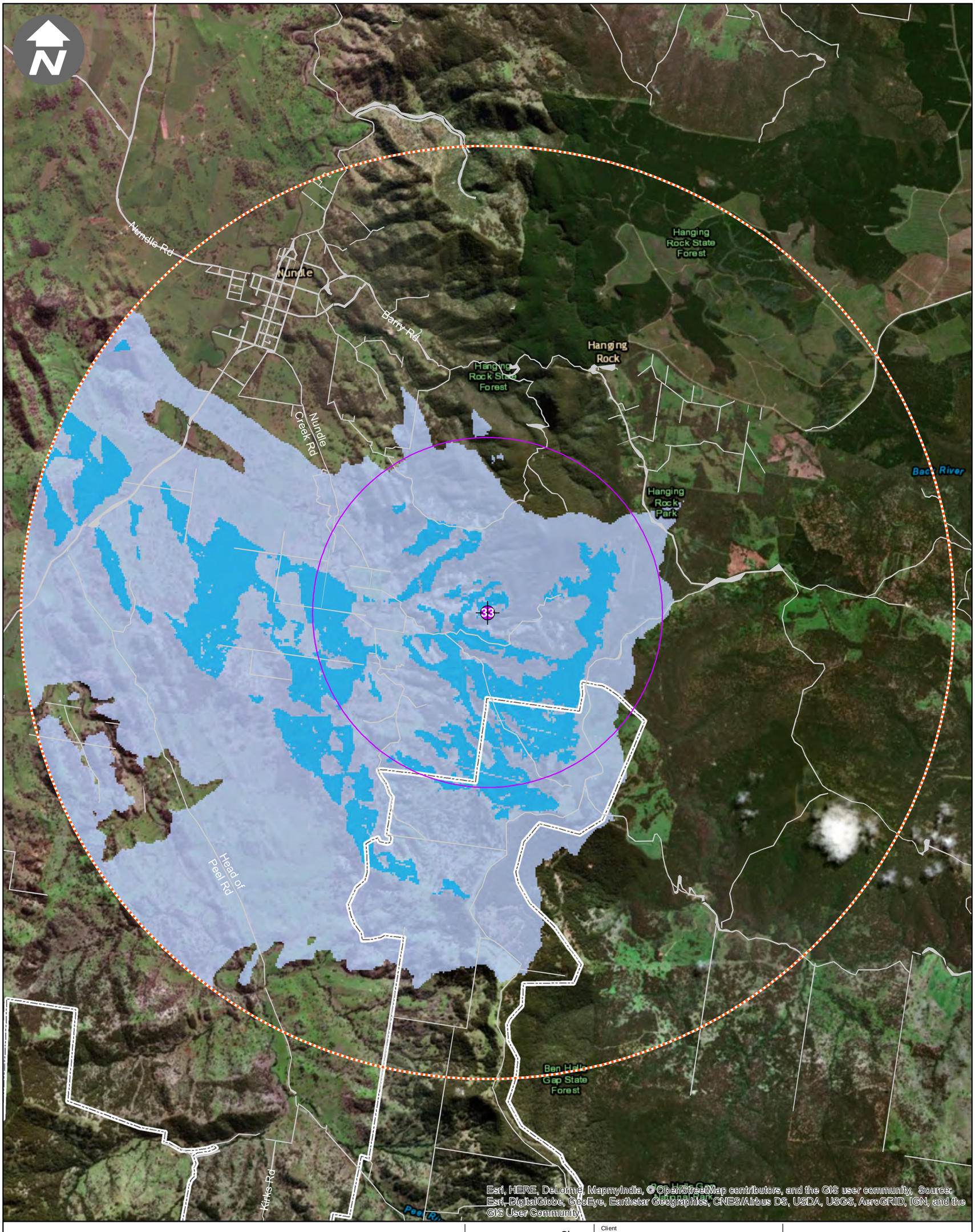
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

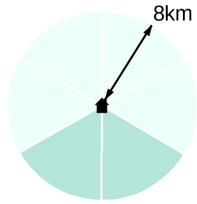
Job No	Figure No
602173-79	**NWF-32**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1470m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 33**

Metres: 0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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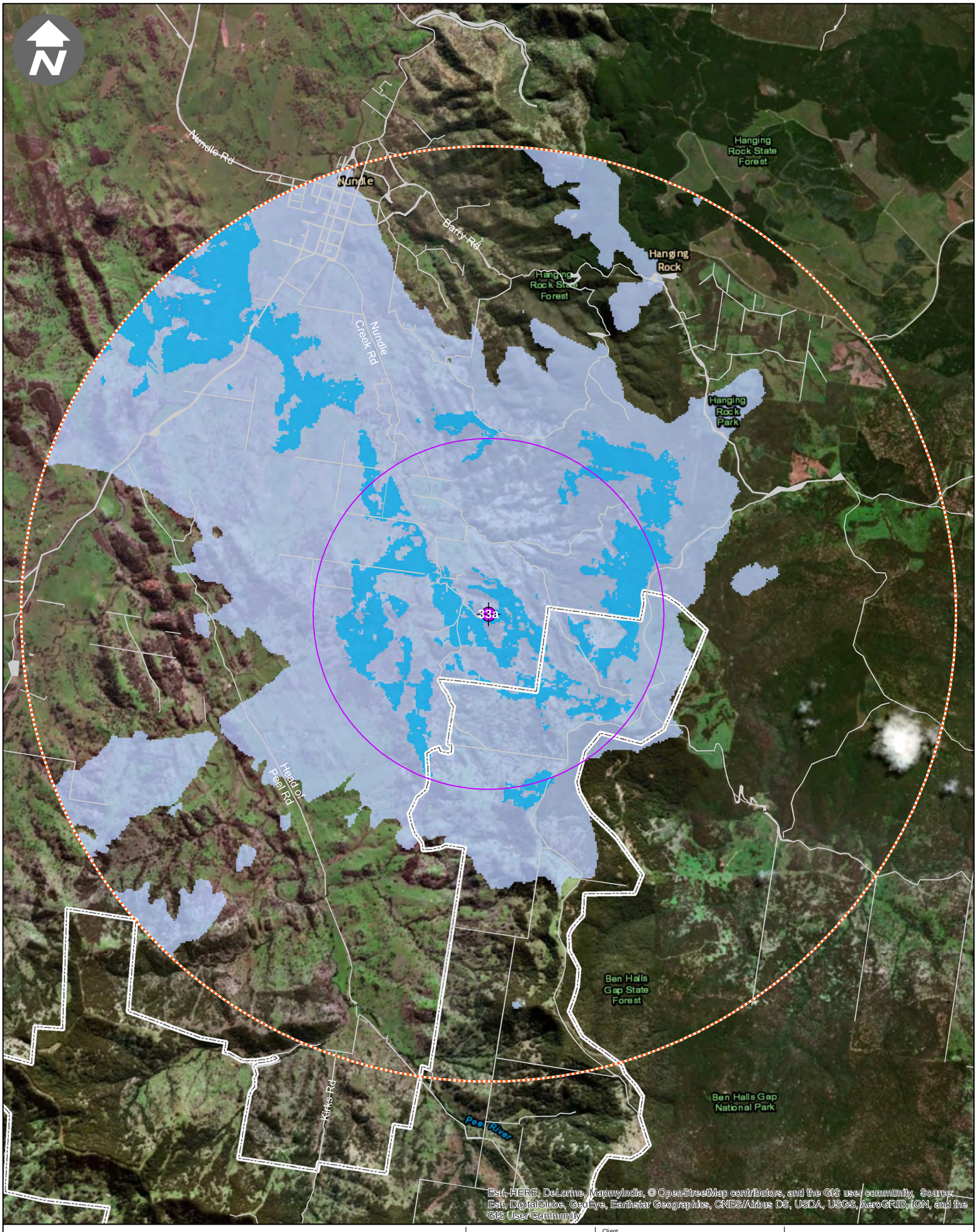
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System: **GDA 1994 MGA Zone 56**

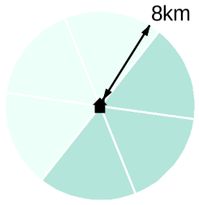
Job No	Figure No
602173-79	**NWF-33**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 997m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 33a

Metres
0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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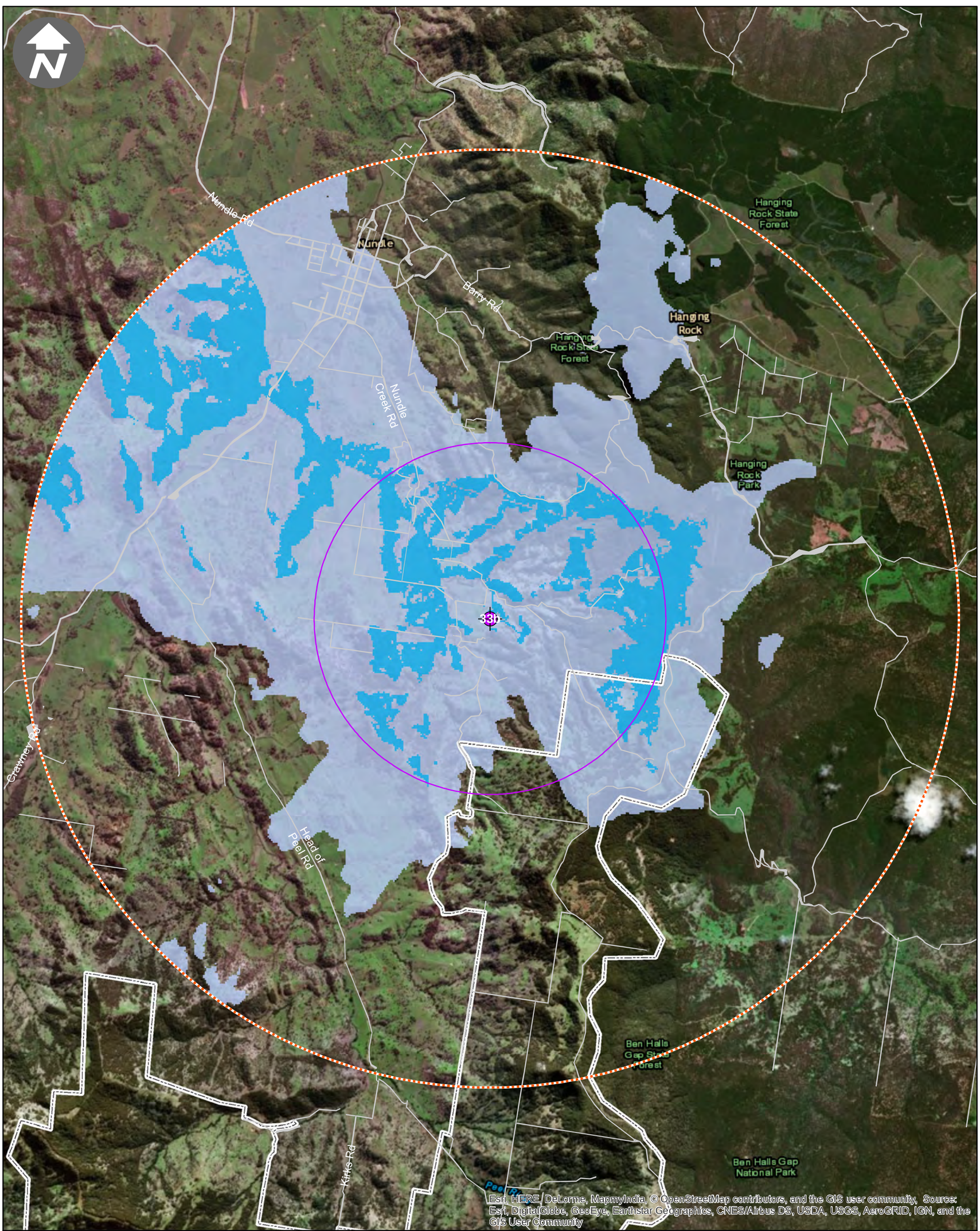
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

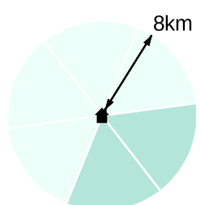
Job No	Figure No
602173-79	**NWF-33a**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1608m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 33b**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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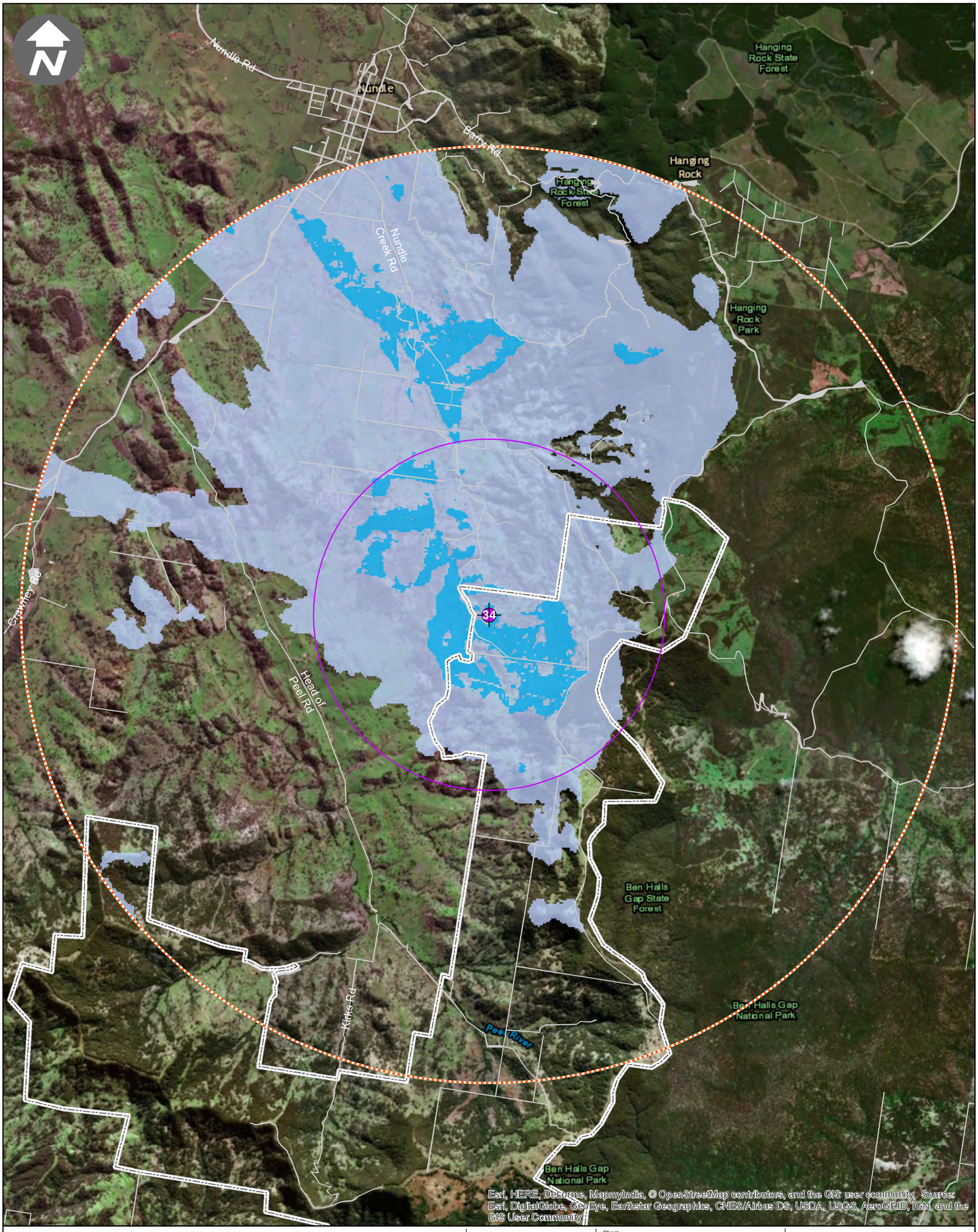
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

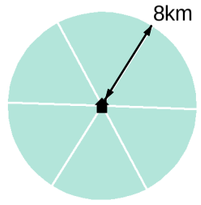
Job No	Figure No
602173-79	NWF-33b



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 261m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 34

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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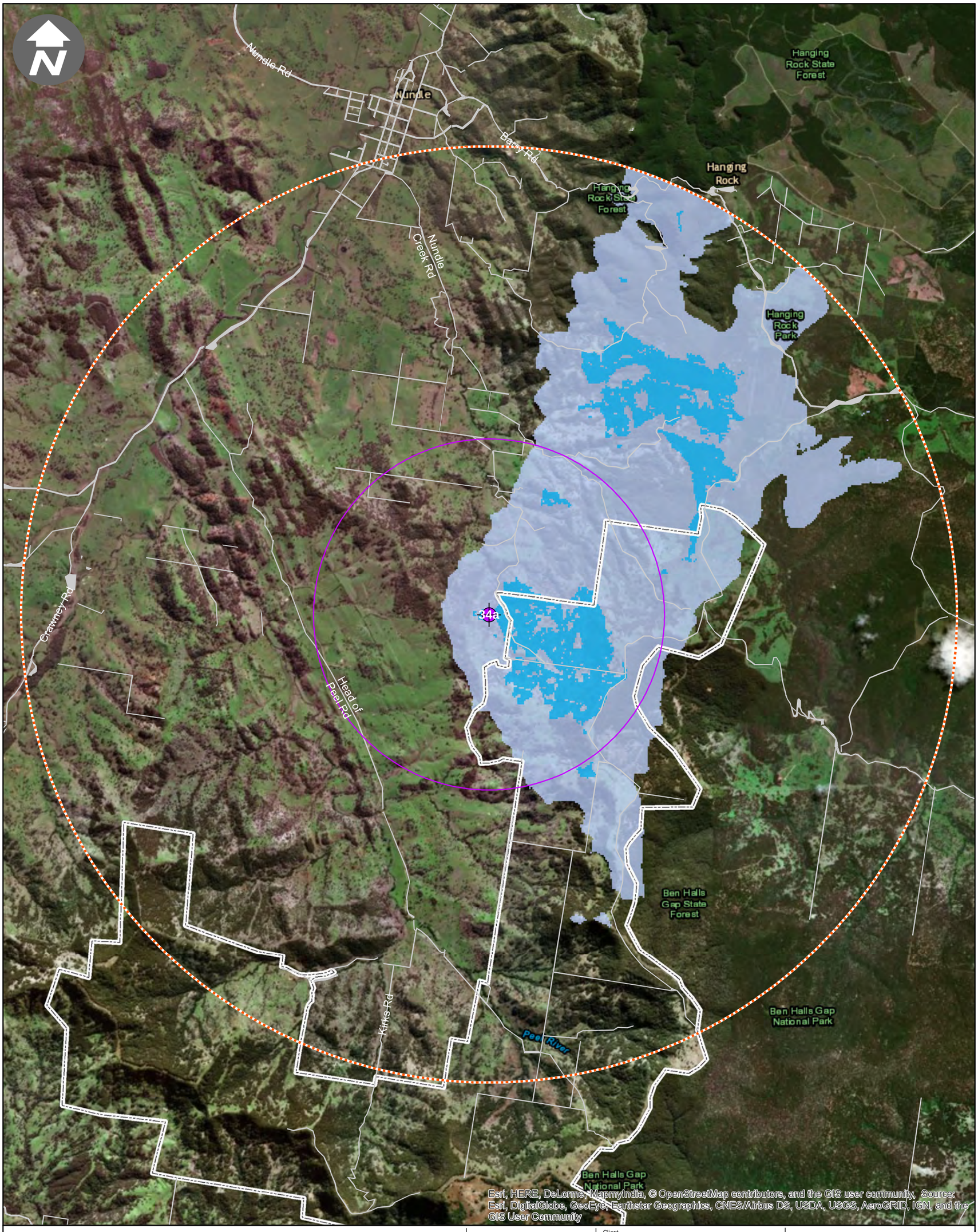
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

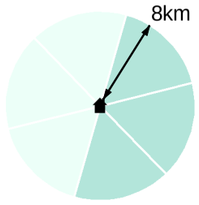
Job No	Figure No
602173-79	**NWF-34**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 162m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 34a

Metres
0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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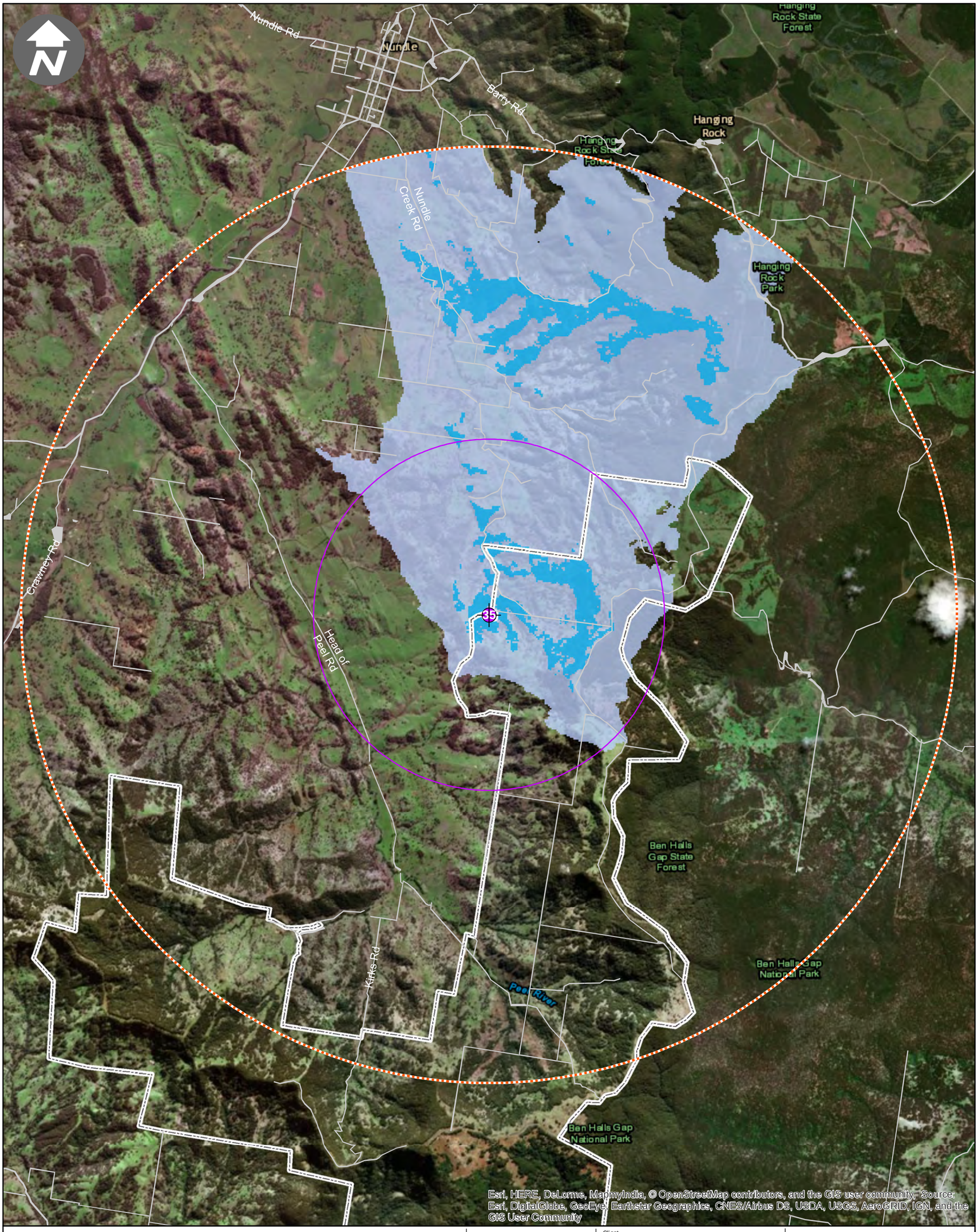
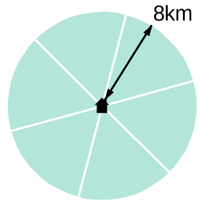
Scale at A3	Figure Status
1:60,000	**Issue**
Coordinate System	
GDA 1994 MGA Zone 56	
Job No	Figure No
602173-79	**NWF-34a**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 69m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 35**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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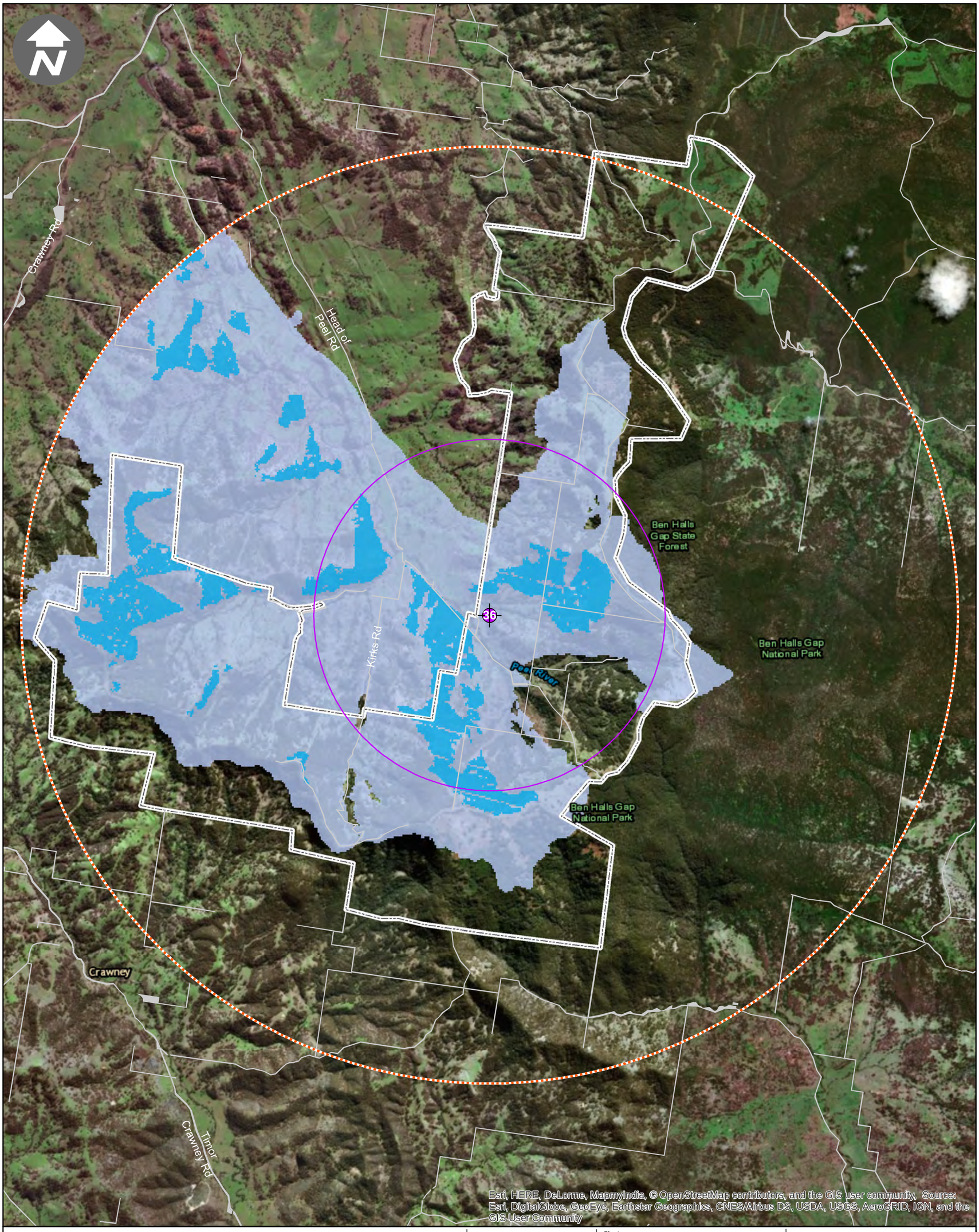
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

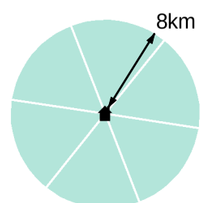
Job No	Figure No
602173-79	NWF-35



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 226m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 36**

Metres: 0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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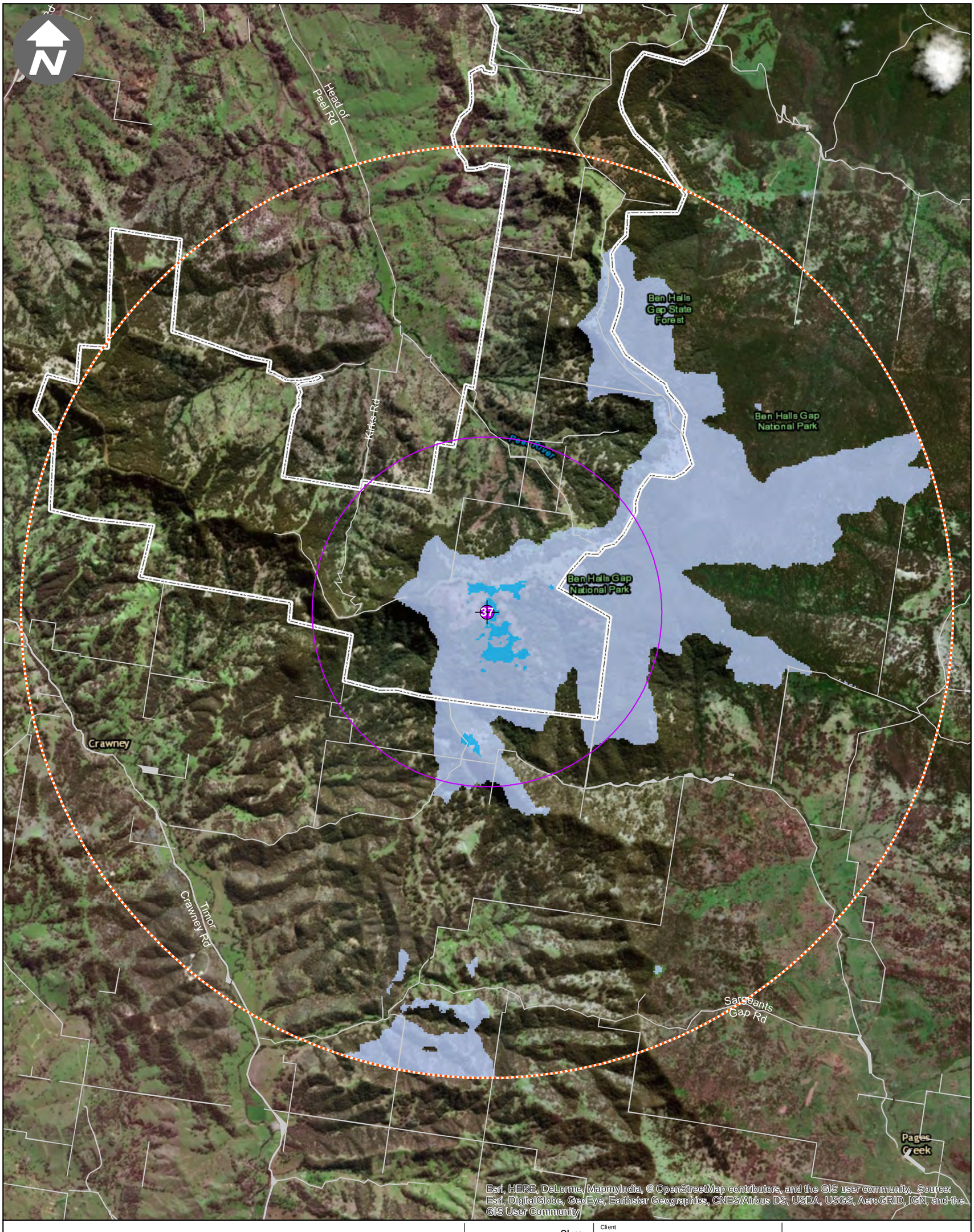
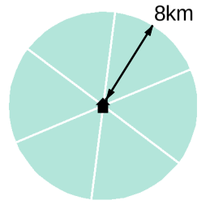
Scale at A3: **1:60,000**	Figure Status: **Issue**
Coordinate System: **GDA 1994 MGA Zone 56**	
Job No: **602173-79**	Figure No: **NWF-36**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 401m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 37

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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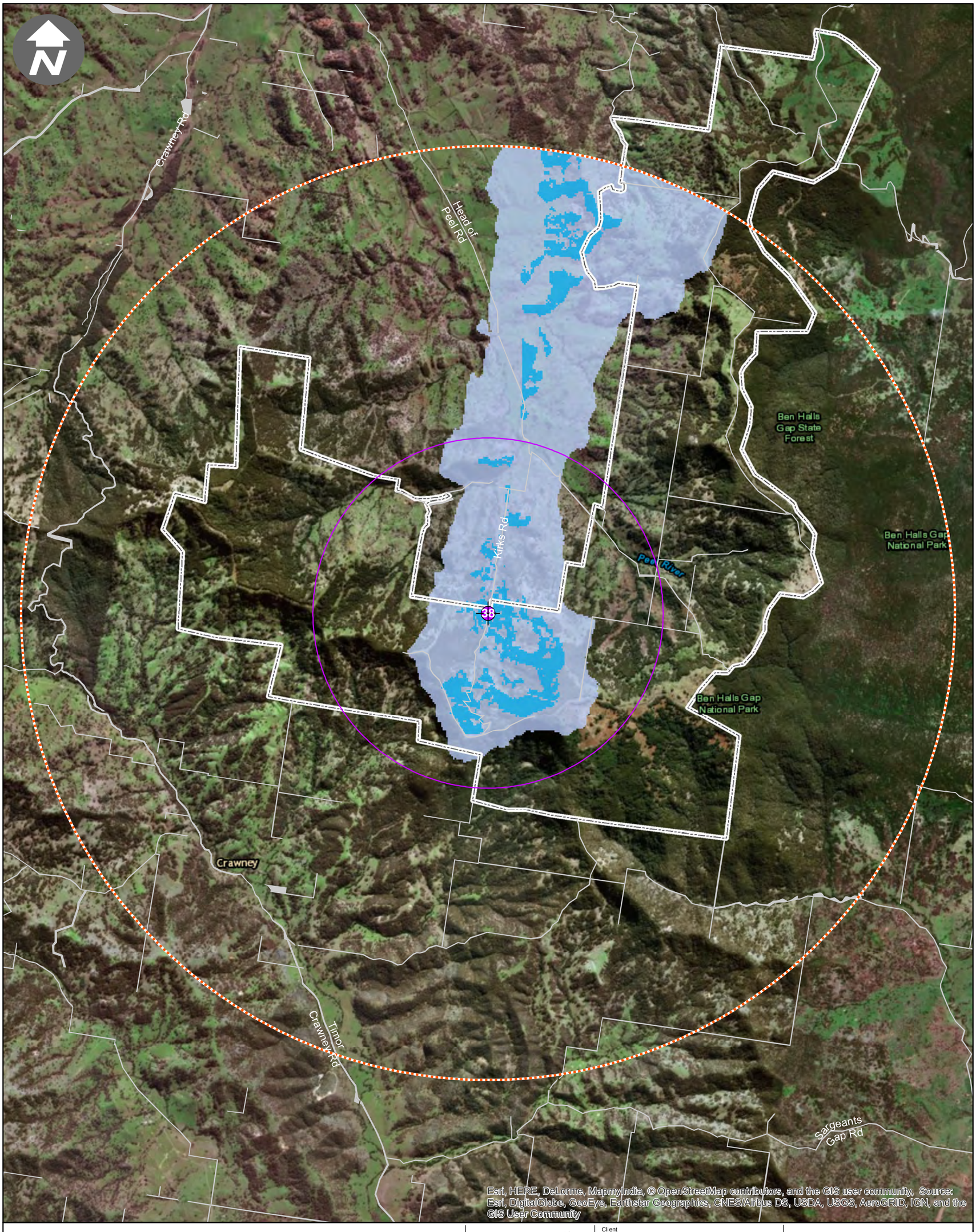
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

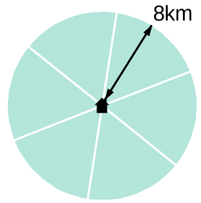
Job No	Figure No
602173-79	**NWF-37**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 86m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 38

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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Tel +61 (7)3023 6000 Fax +61 (7)3023 6023
www.arup.com

Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

Job No	Figure No
602173-79	**NWF-38**

Ben Halls Gap State Forest

Ben Halls National

Kirks Rd

Peel River

Ben Halls Gap National Park

Crawney

39

Crawney Rd

Timor

Sargeants Gap Rd

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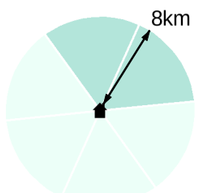
Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1245m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 39**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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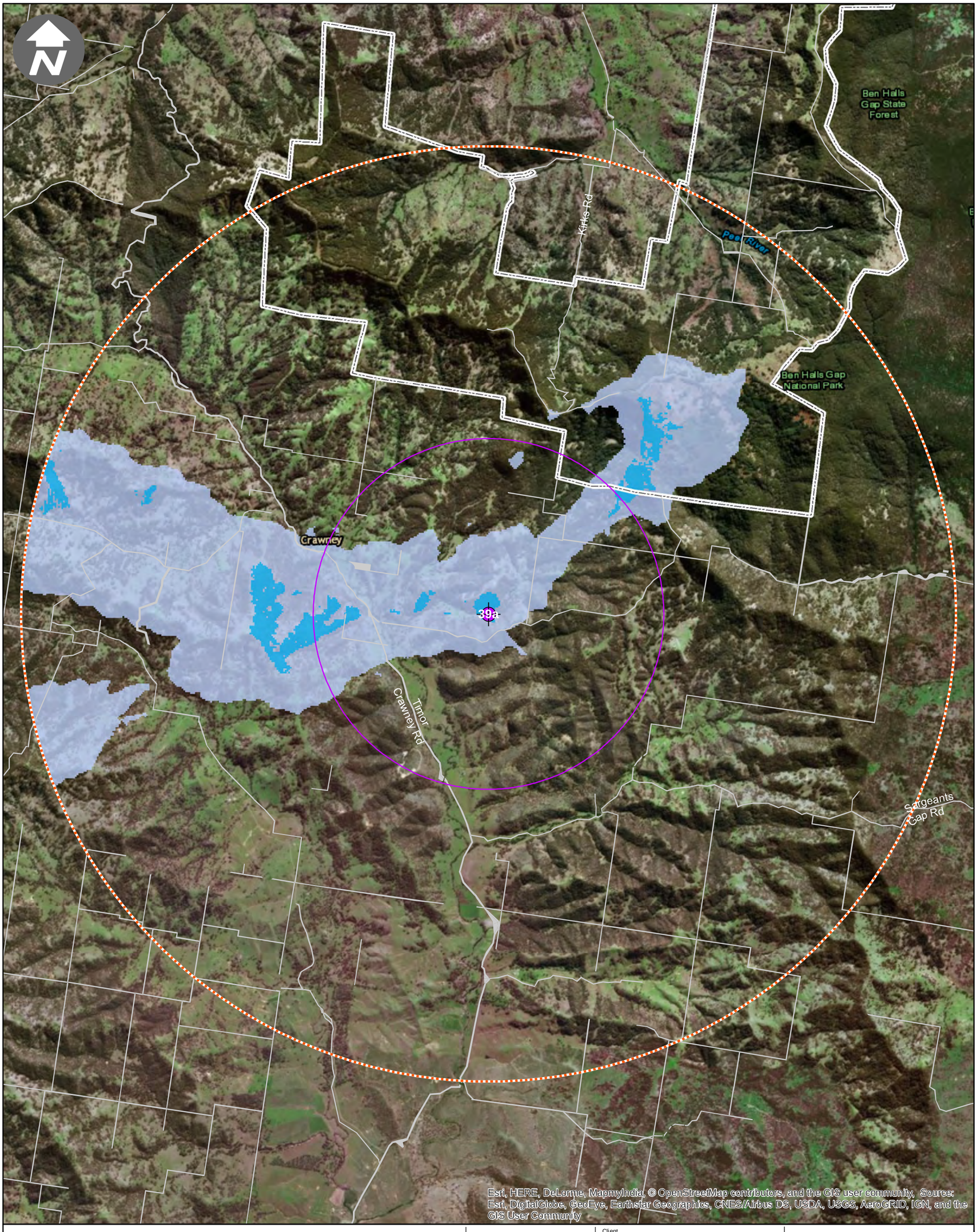
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

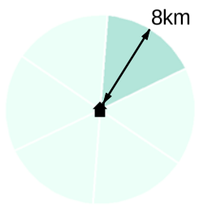
Job No	Figure No
602173-79	NWF-39



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 2109m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 39a

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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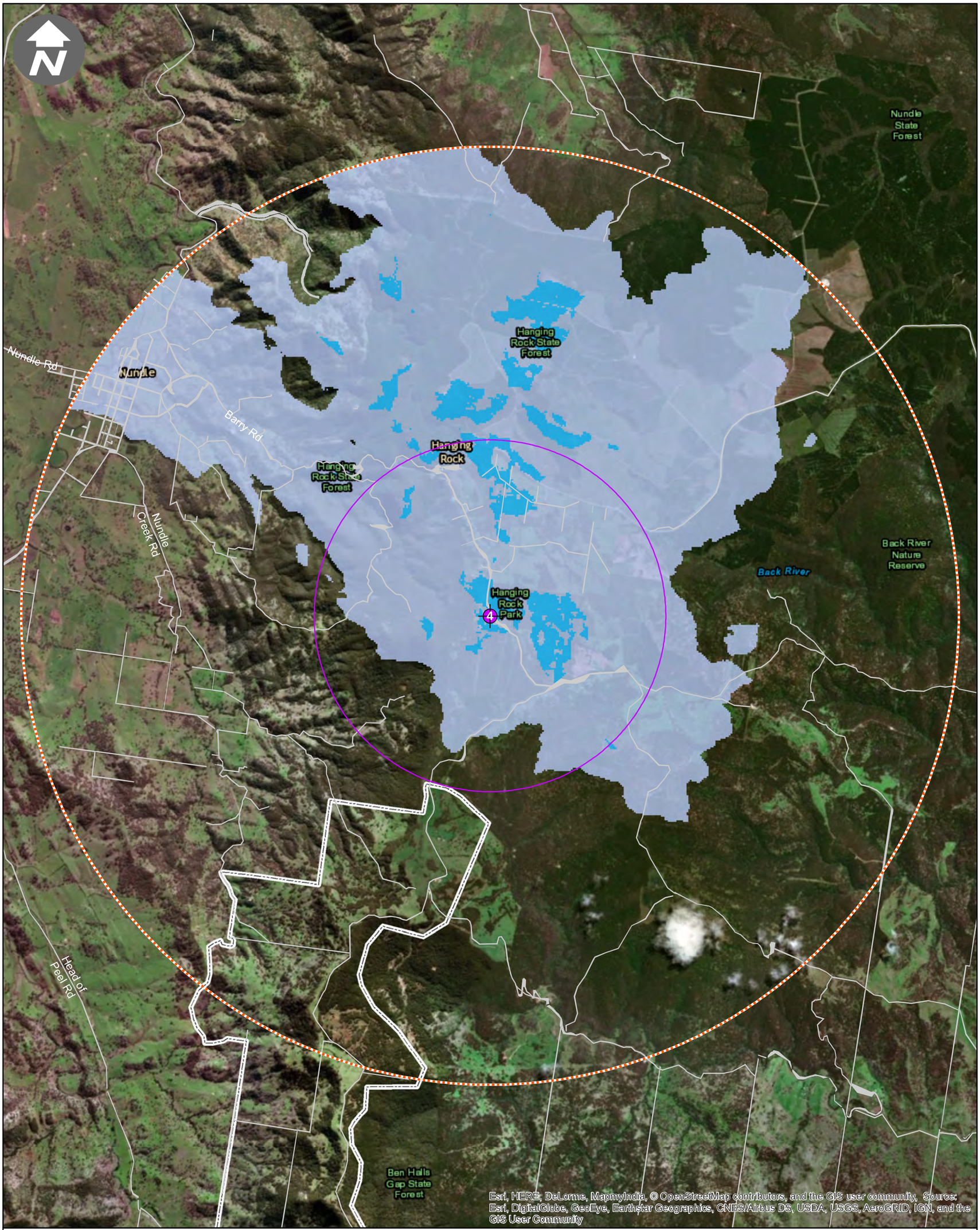
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

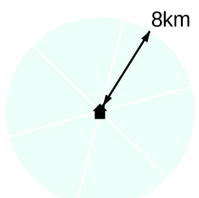
Job No	Figure No
602173-79	**NWF-39a**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3031m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 4**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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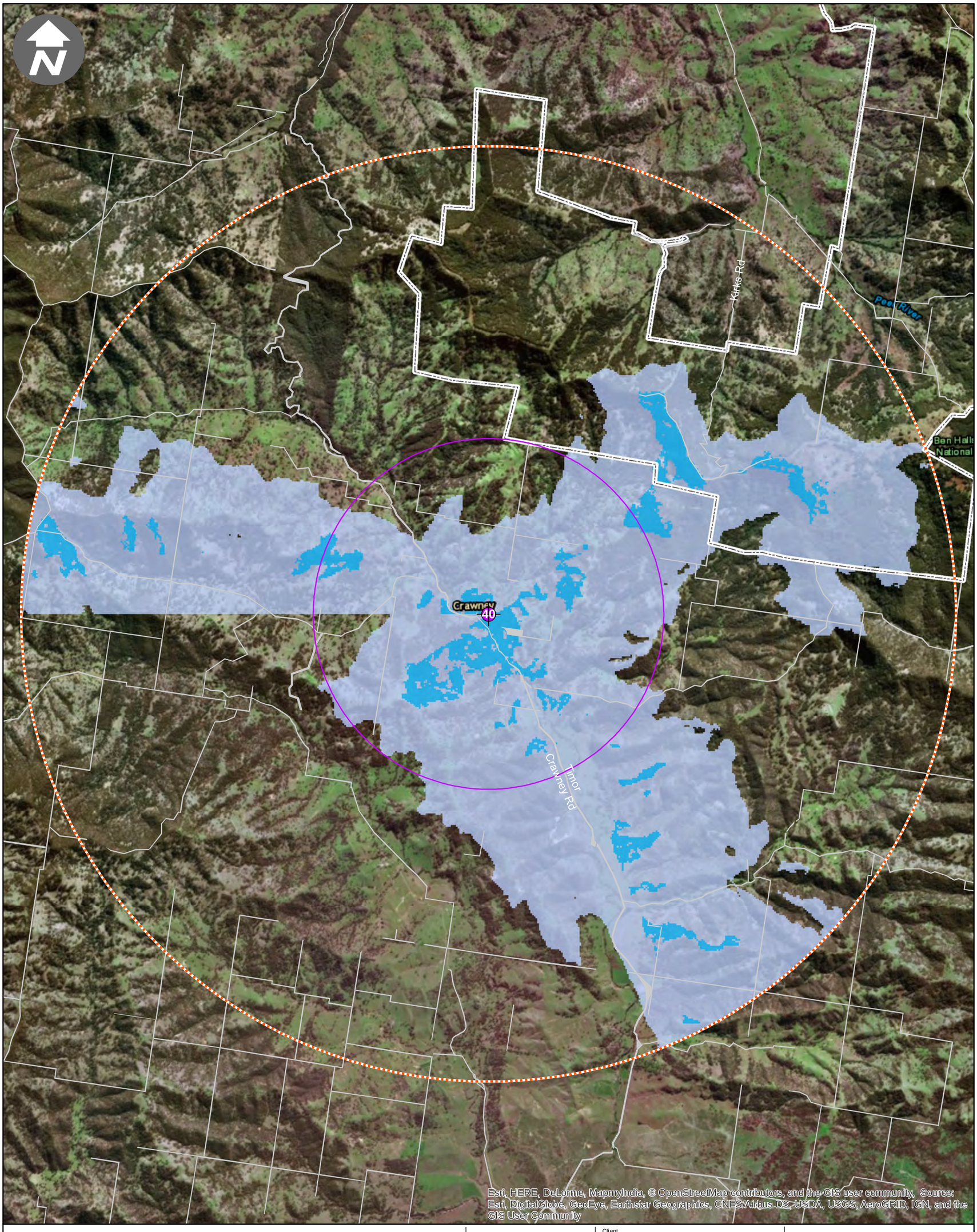
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

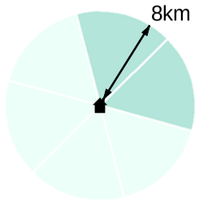
Job No	Figure No
602173-79	NWF-4



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1776m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 40**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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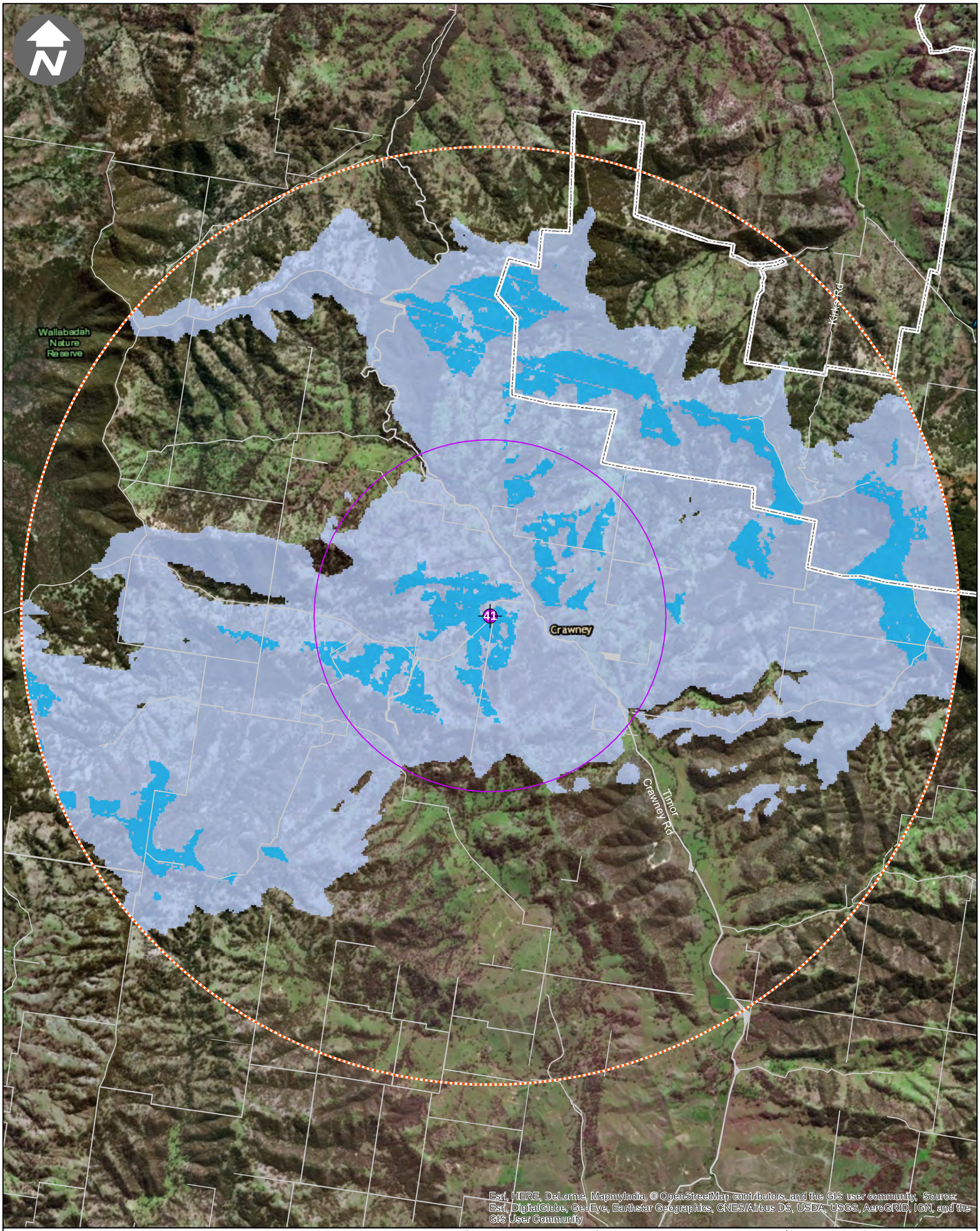
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

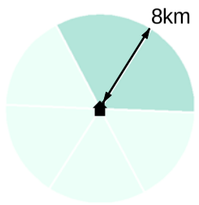
Job No	Figure No
602173-79	NWF-40



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 2465m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 41**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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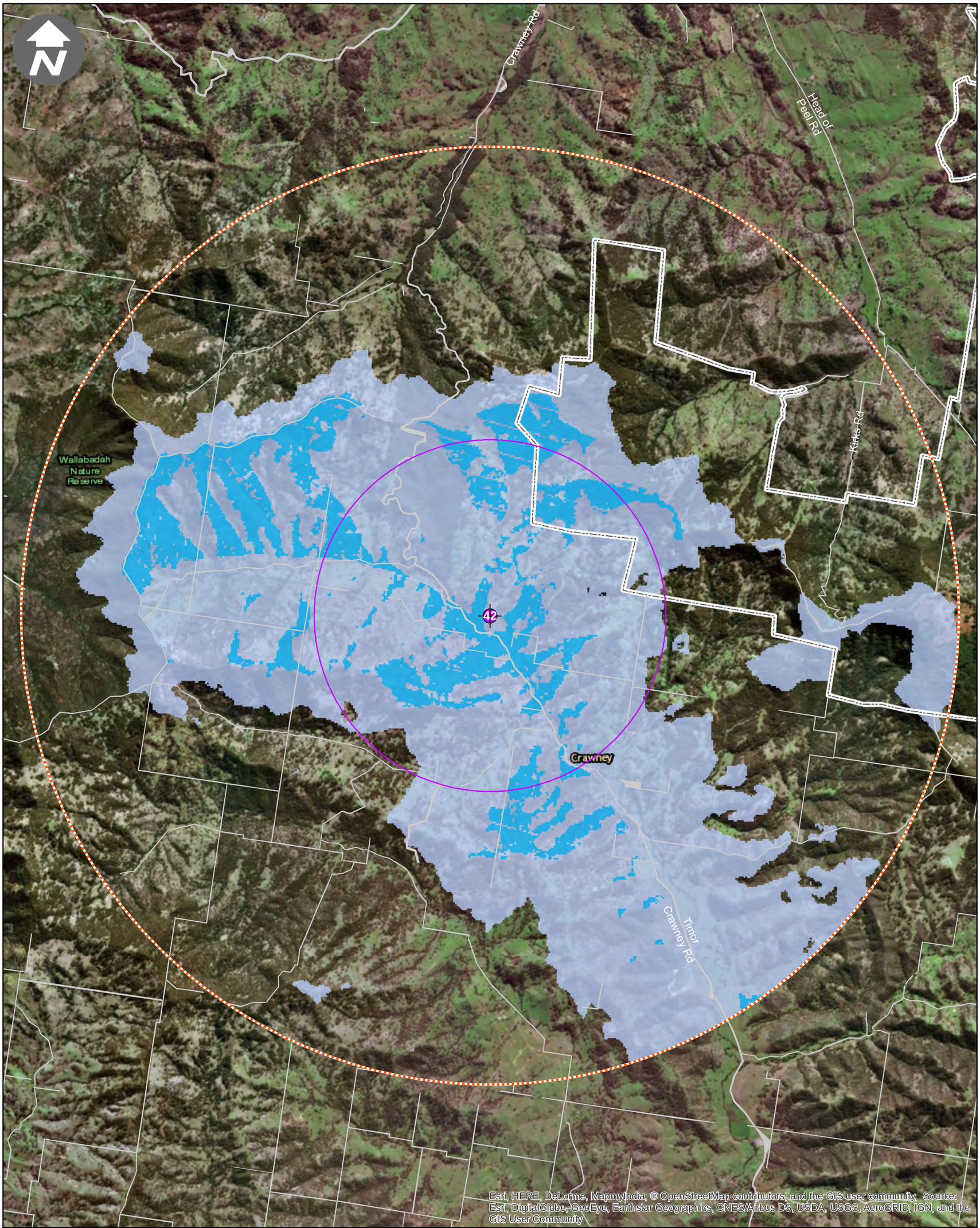
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

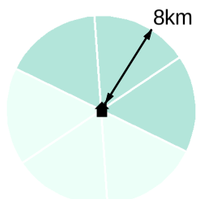
Job No	Figure No
602173-79	NWF-41



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 390m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 42**

Metres: 0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

ARUP

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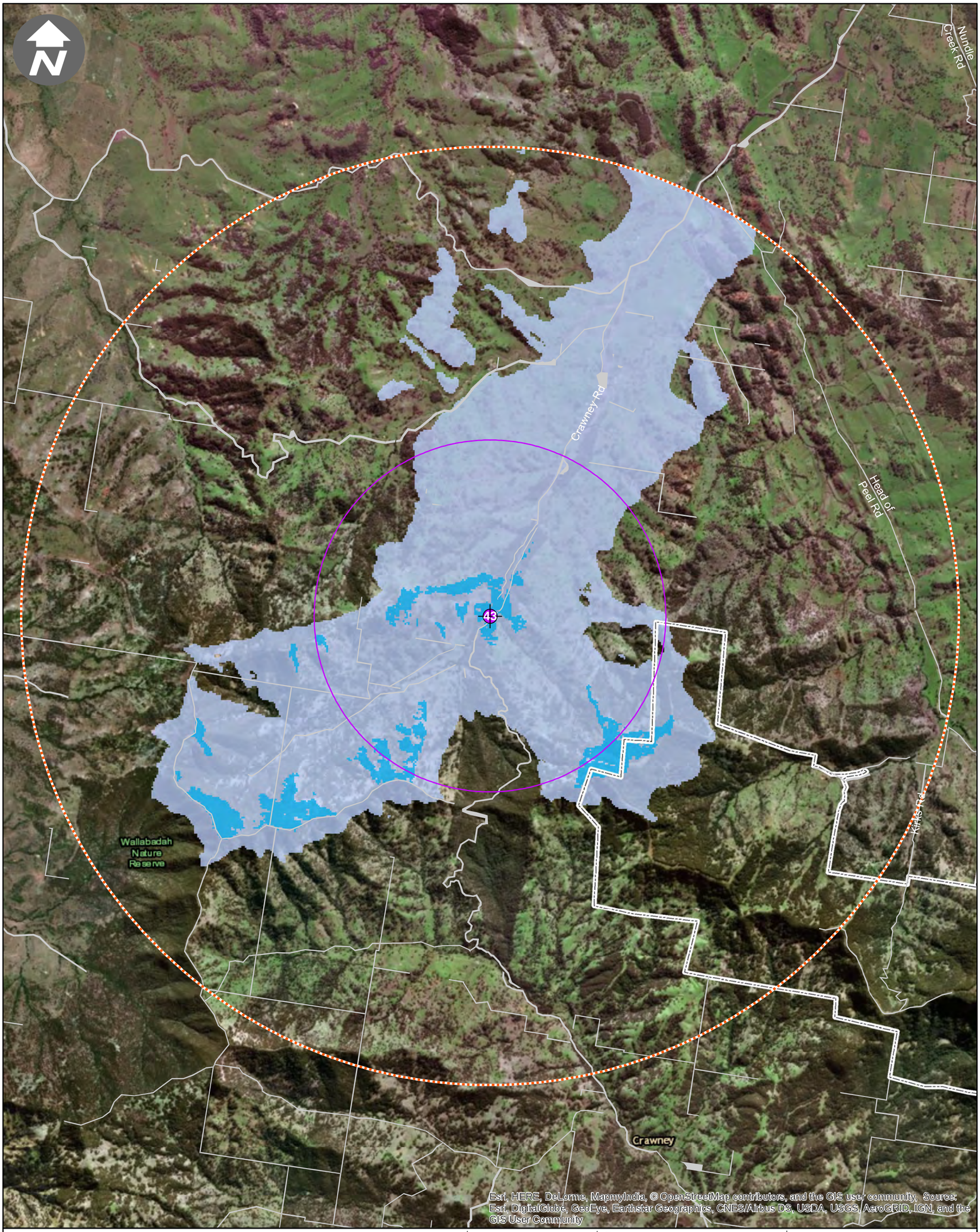
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

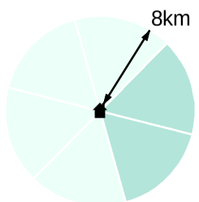
Job No	Figure No
602173-79	NWF-42



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1922m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 43**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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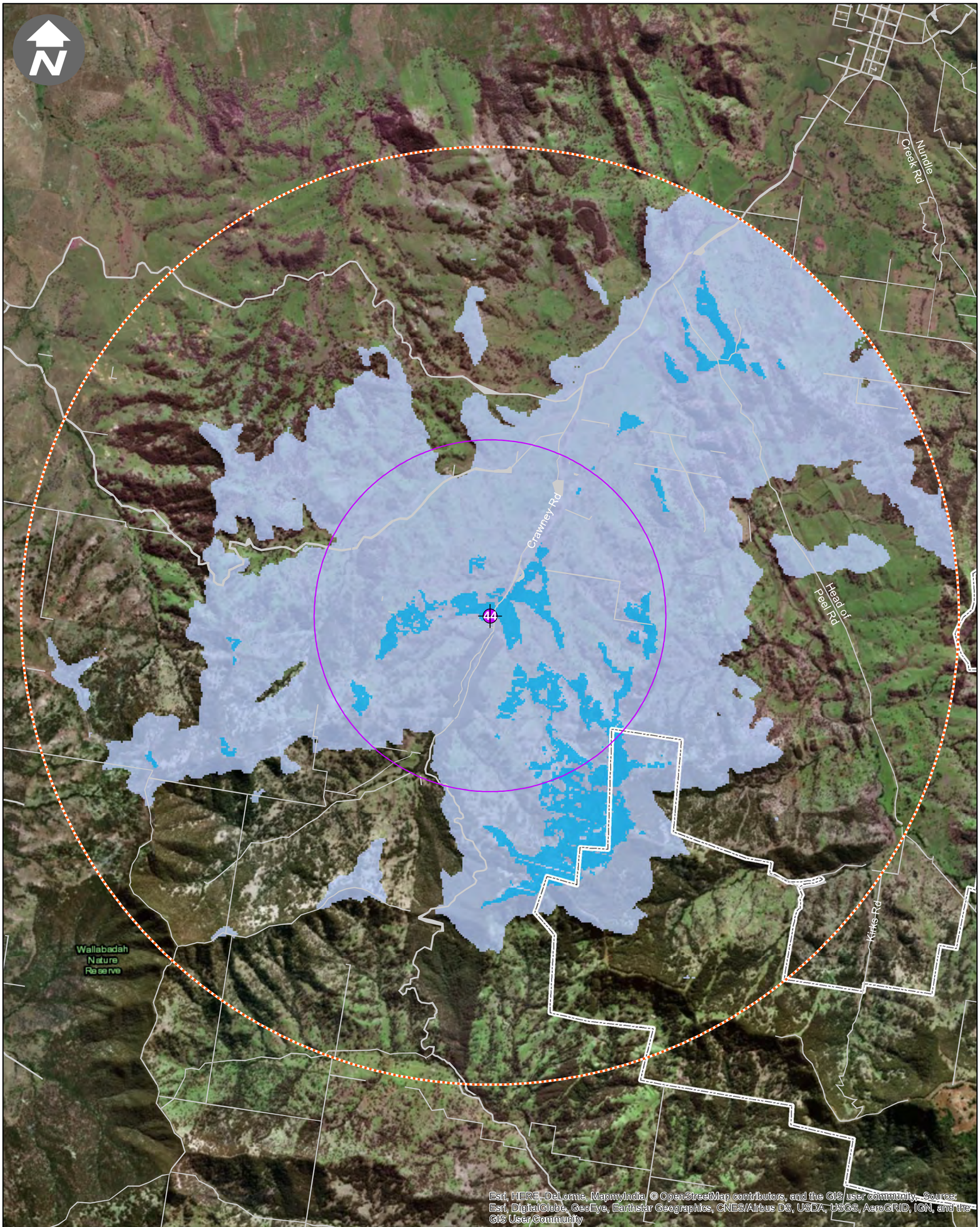
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

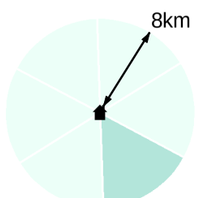
Job No	Figure No
602173-79	NWF-43



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 2432m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 44**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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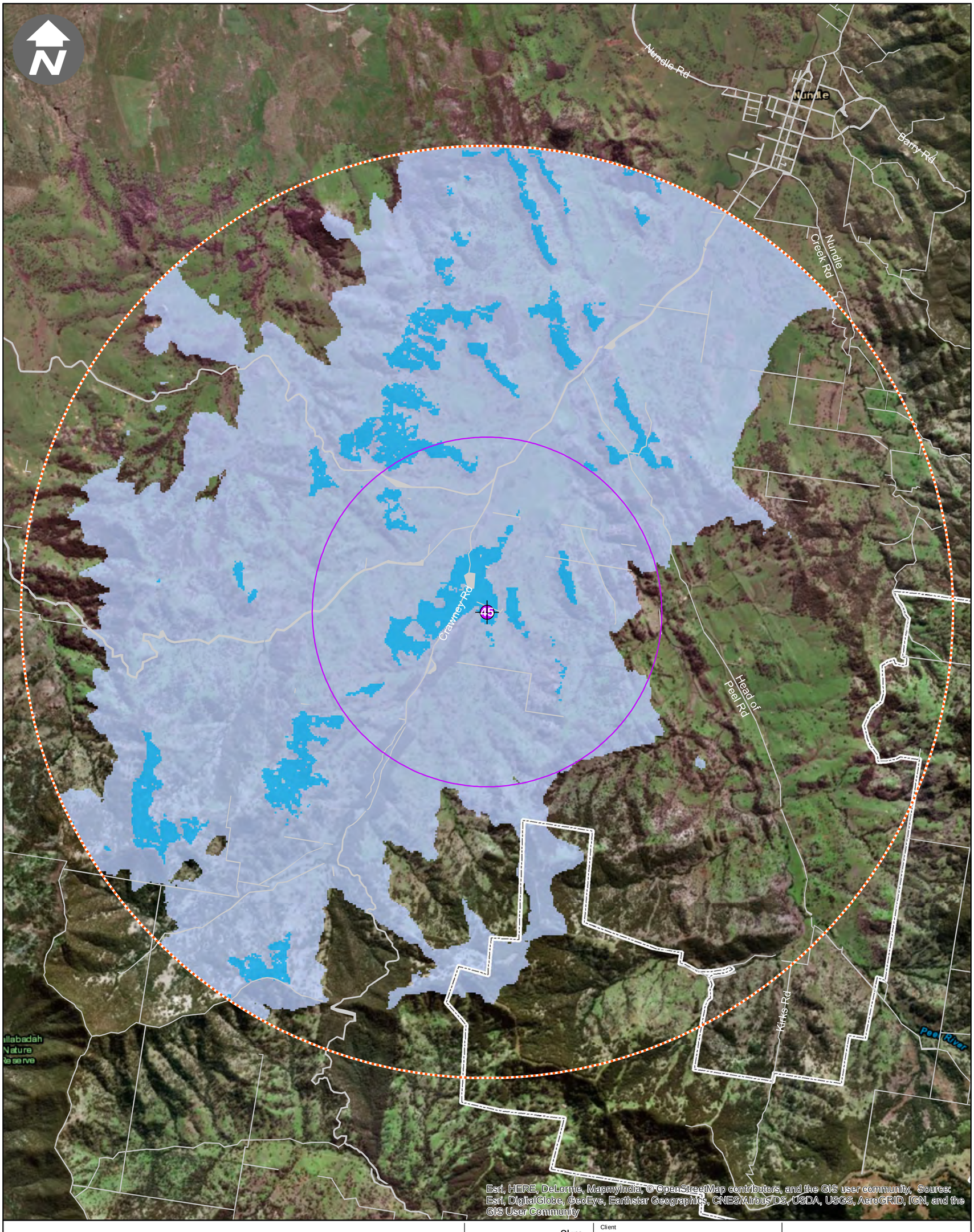
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

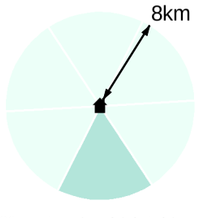
Job No	Figure No
602173-79	NWF-44



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3007m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 45

Metres
0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

ARUP

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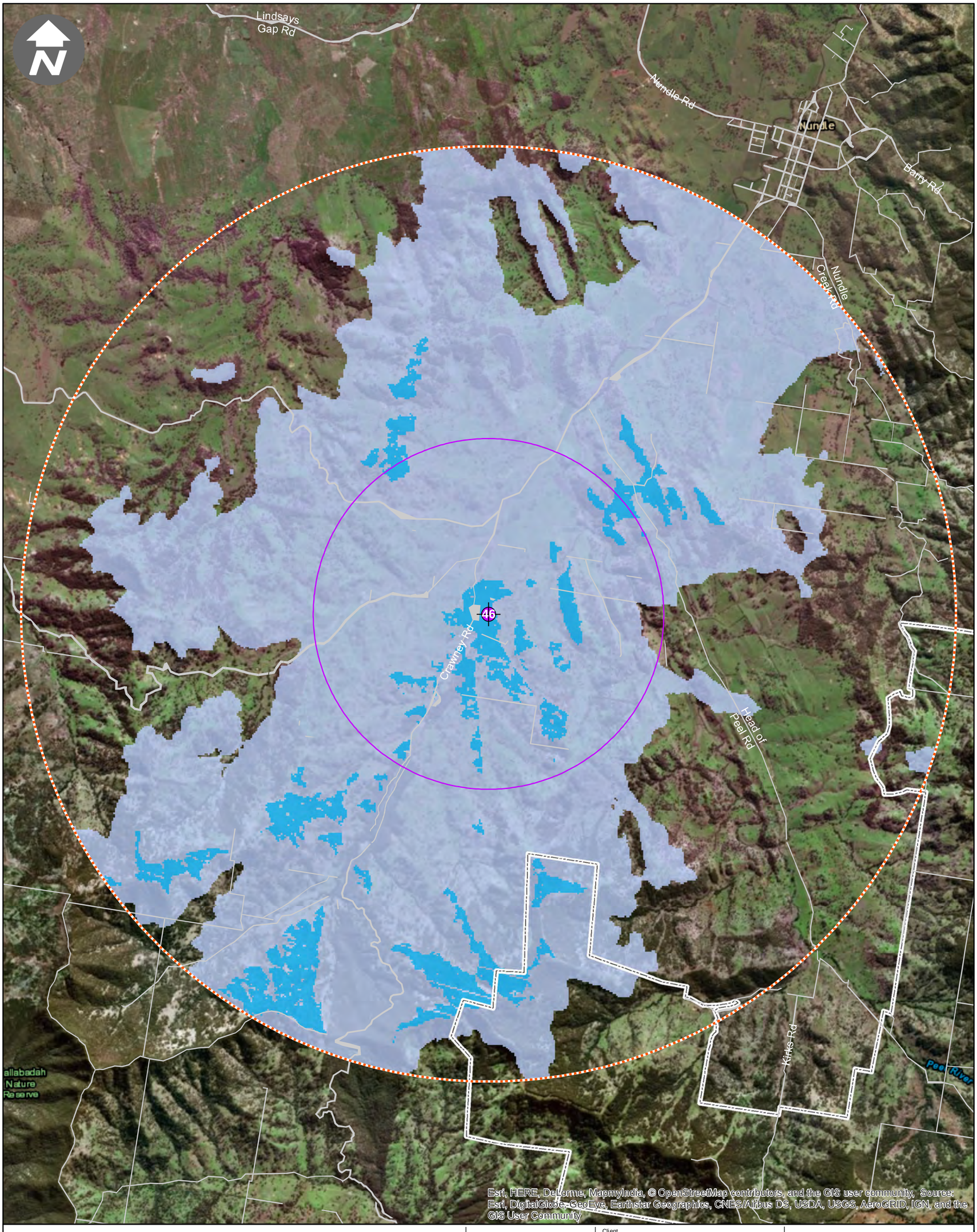
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

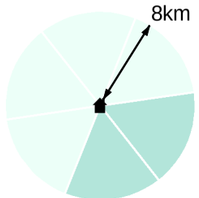
Job No	Figure No
602173-79	**NWF-45**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3519m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 46**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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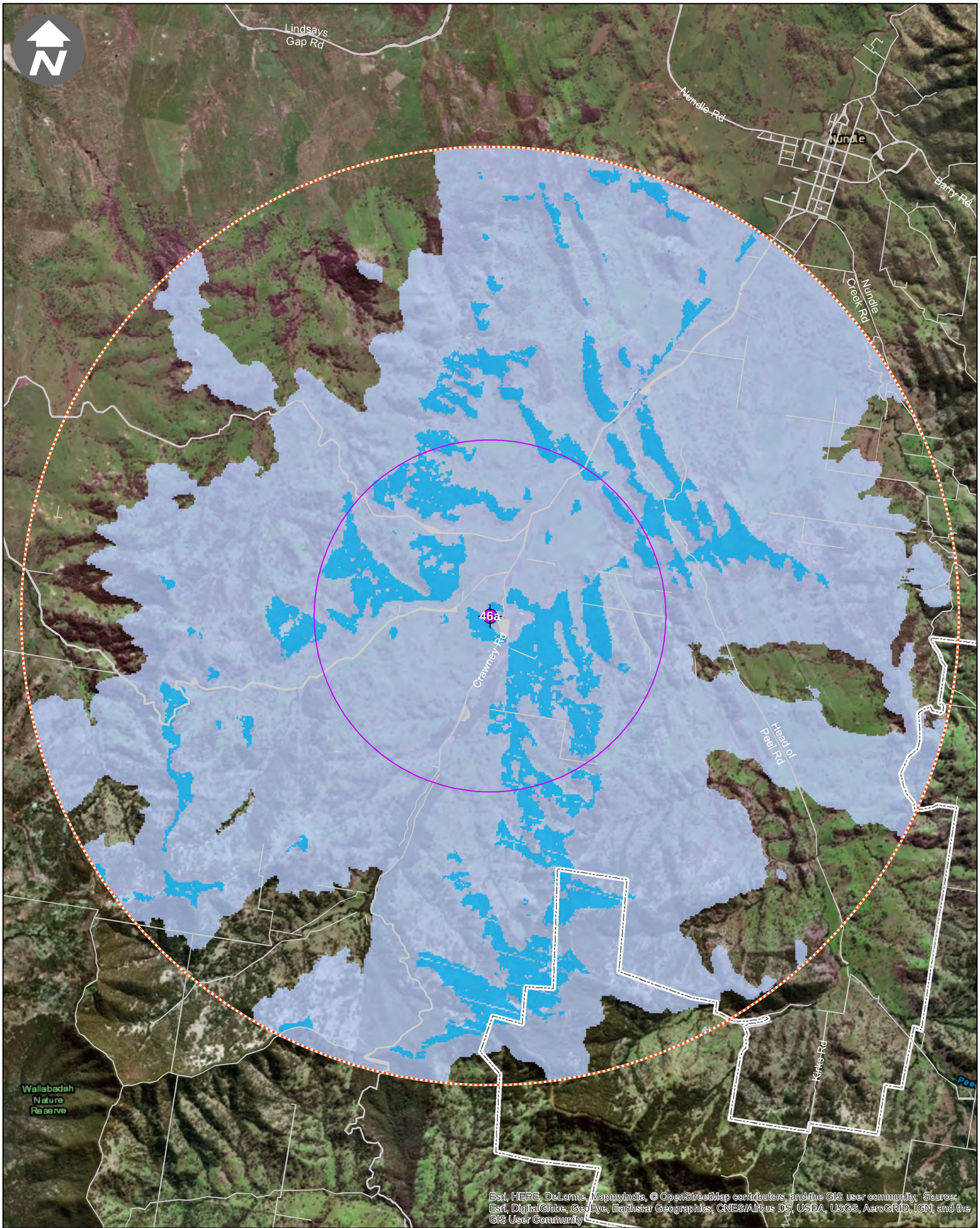
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System: **GDA 1994 MGA Zone 56**

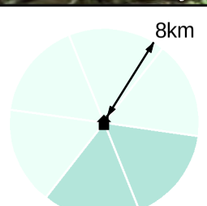
Job No	Figure No
602173-79	**NWF-46**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3877m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 46a

Metres
0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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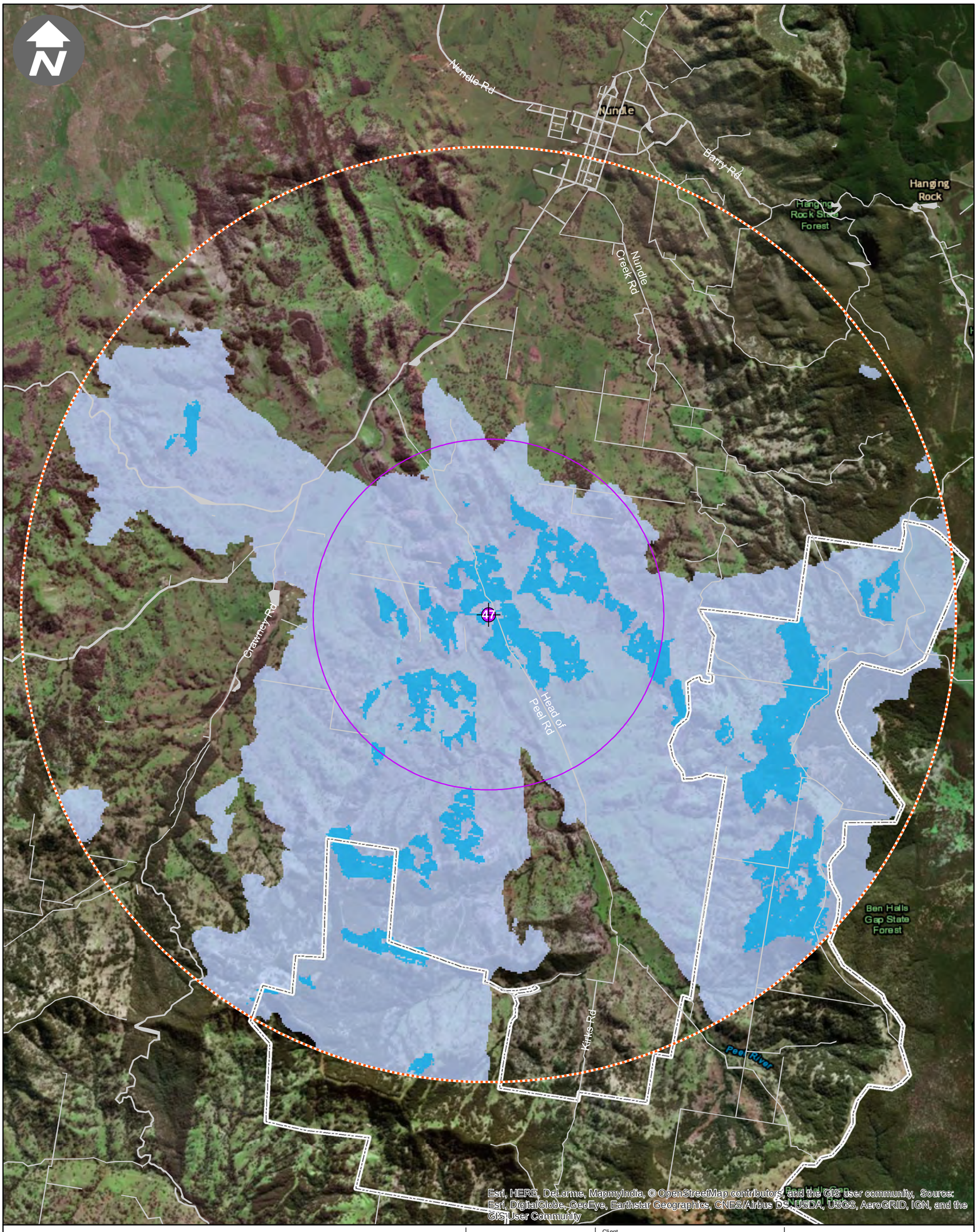
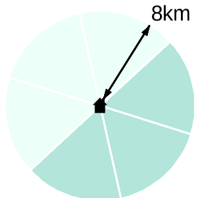
Scale at A3	Figure Status
1:60,000	**Issue**
Coordinate System	
GDA 1994 MGA Zone 56	
Job No	Figure No
602173-79	**NWF-46a**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3140m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 47

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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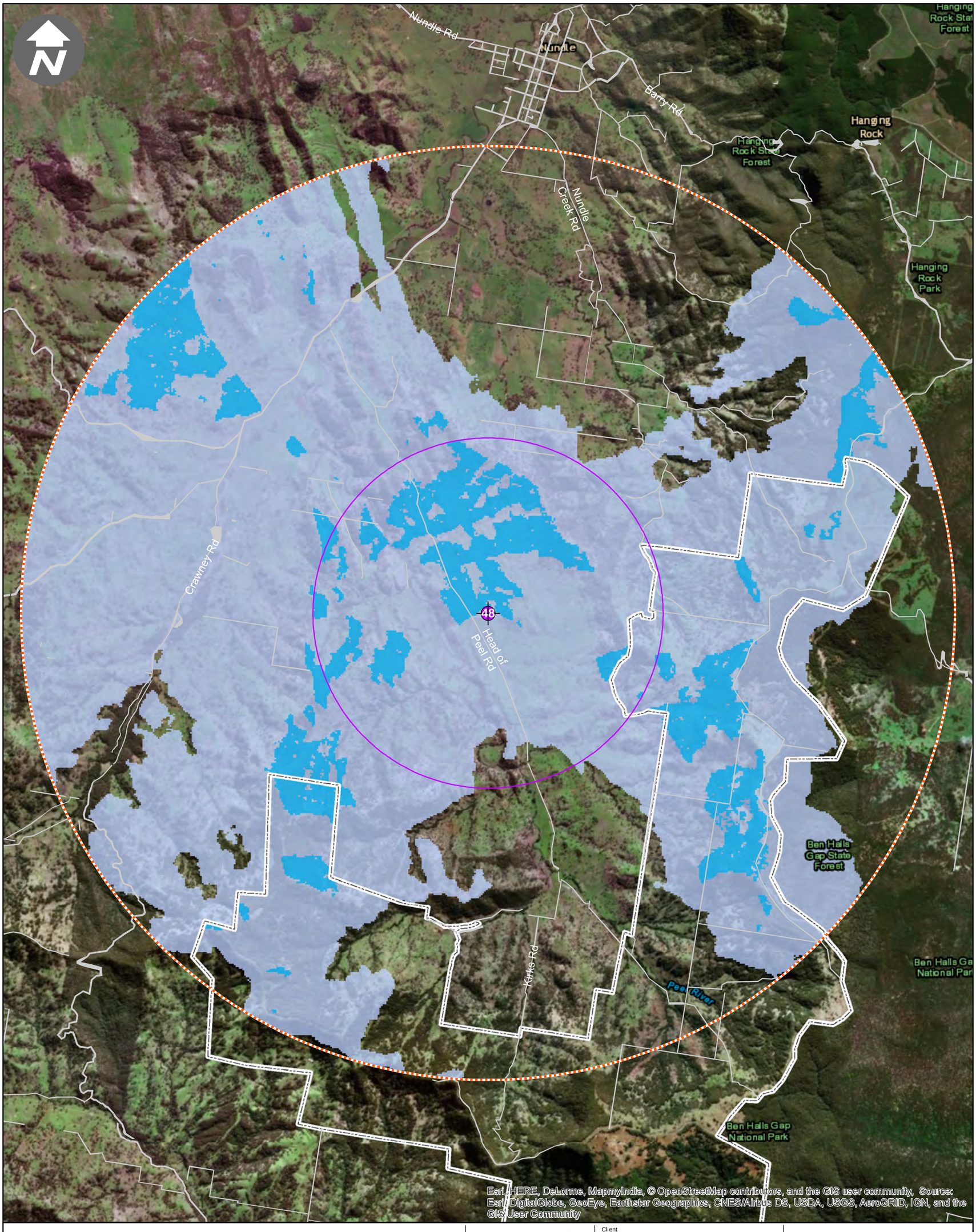
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

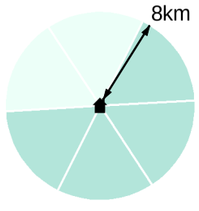
Job No	Figure No
602173-79	**NWF-47**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 2148m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 48

Metres
0 500 1,000 1,500 2,000

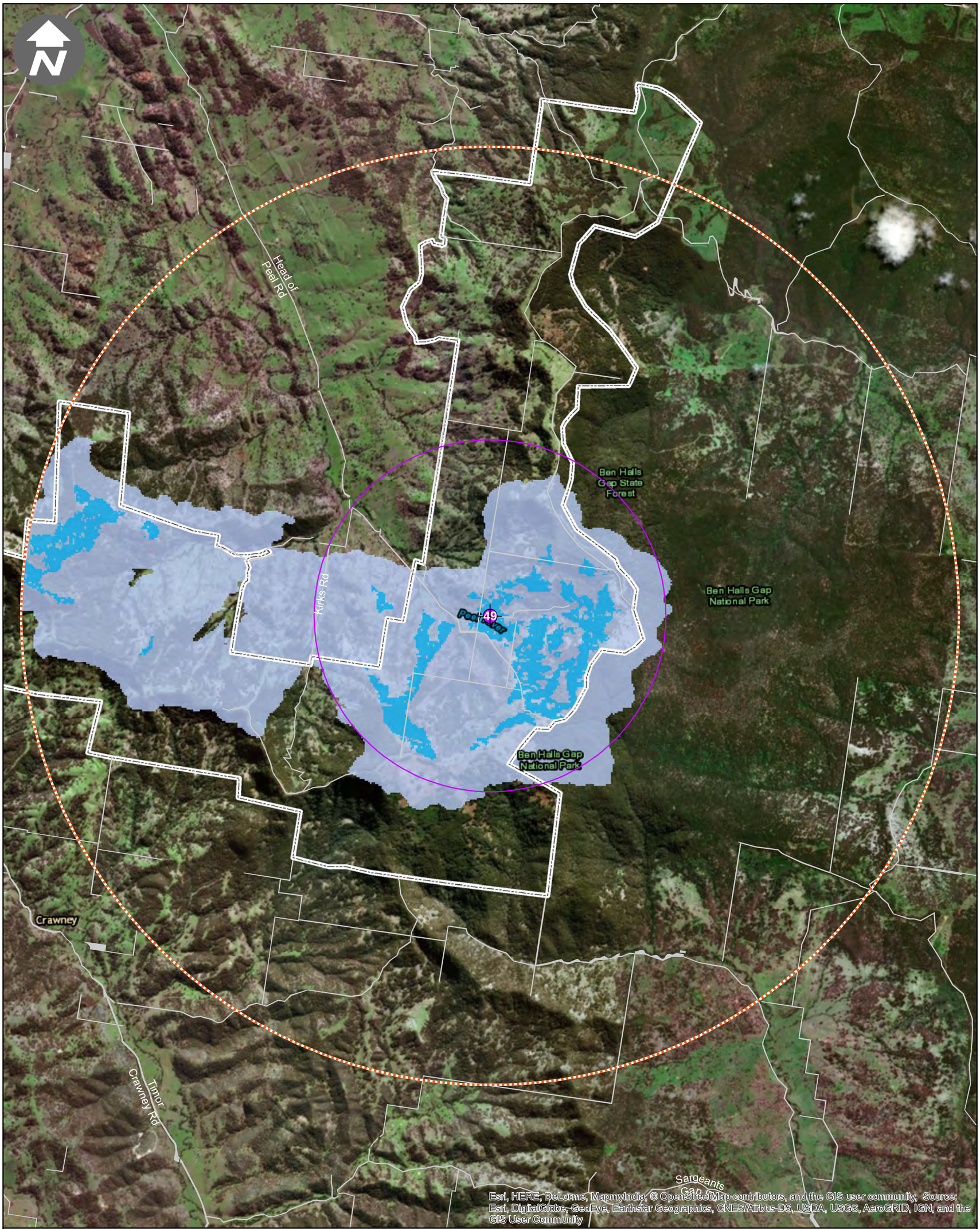
Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

ARUP
Level 4, 108 Wickham Street
Fortitude Valley, QLD 4006
Tel +61 (7)3023 6000 Fax +61 (7)3023 6023
www.arup.com

Scale at A3	Figure Status
1:60,000	Issue

Coordinate System
GDA 1994 MGA Zone 56

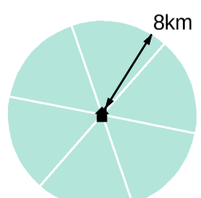
Job No	Figure No
602173-79	NWF-48



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 1432m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 49**

Metres: 0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

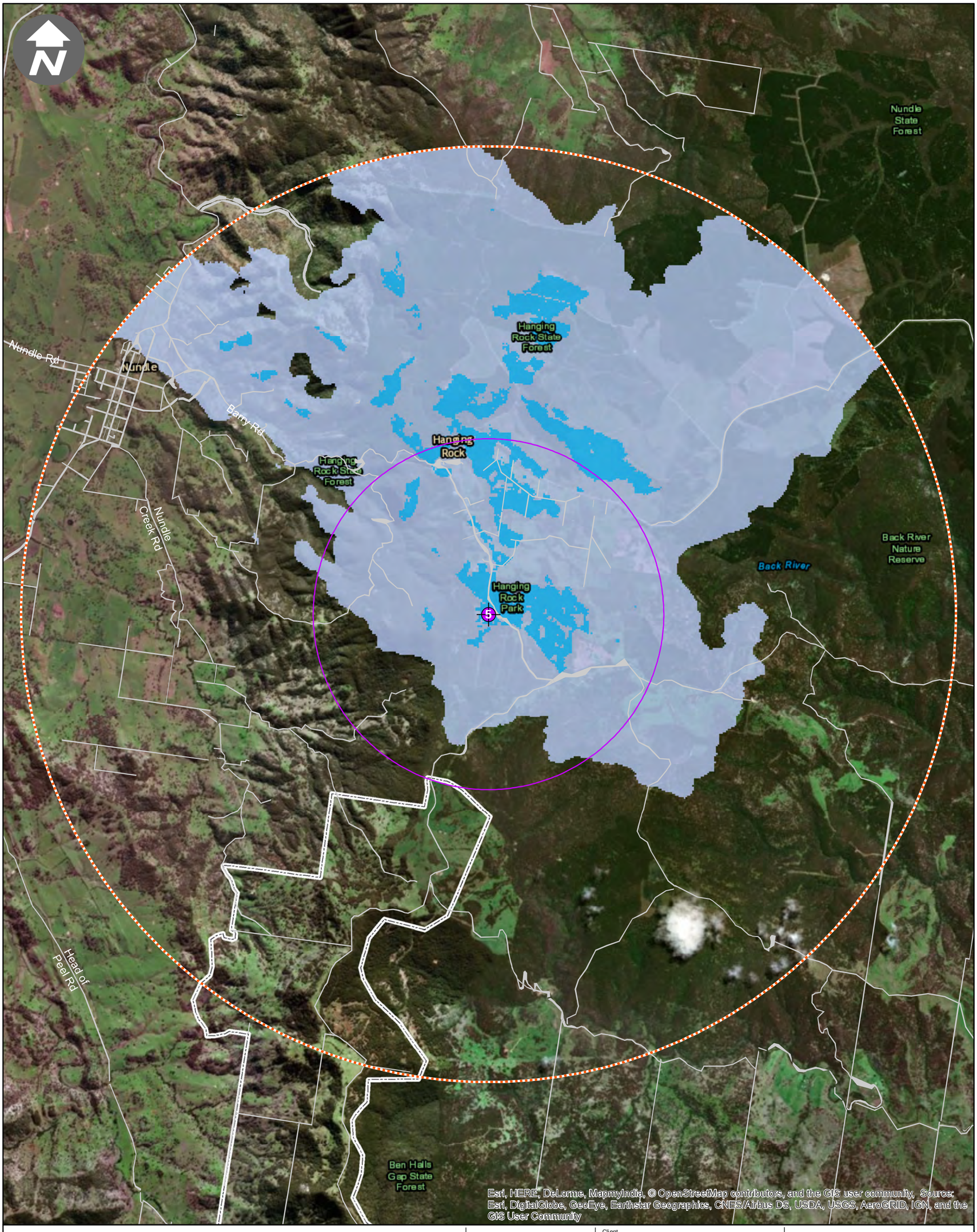
ARUP

Level 4, 108 Wickham Street
Fortitude Valley, QLD 4006
Tel +61 (7)3023 6000 Fax +61 (7)3023 6023
www.arup.com

Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System: **GDA 1994 MGA Zone 56**

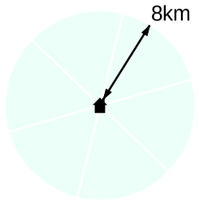
Job No	Figure No
602173-79	**NWF-49**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 2945m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 5**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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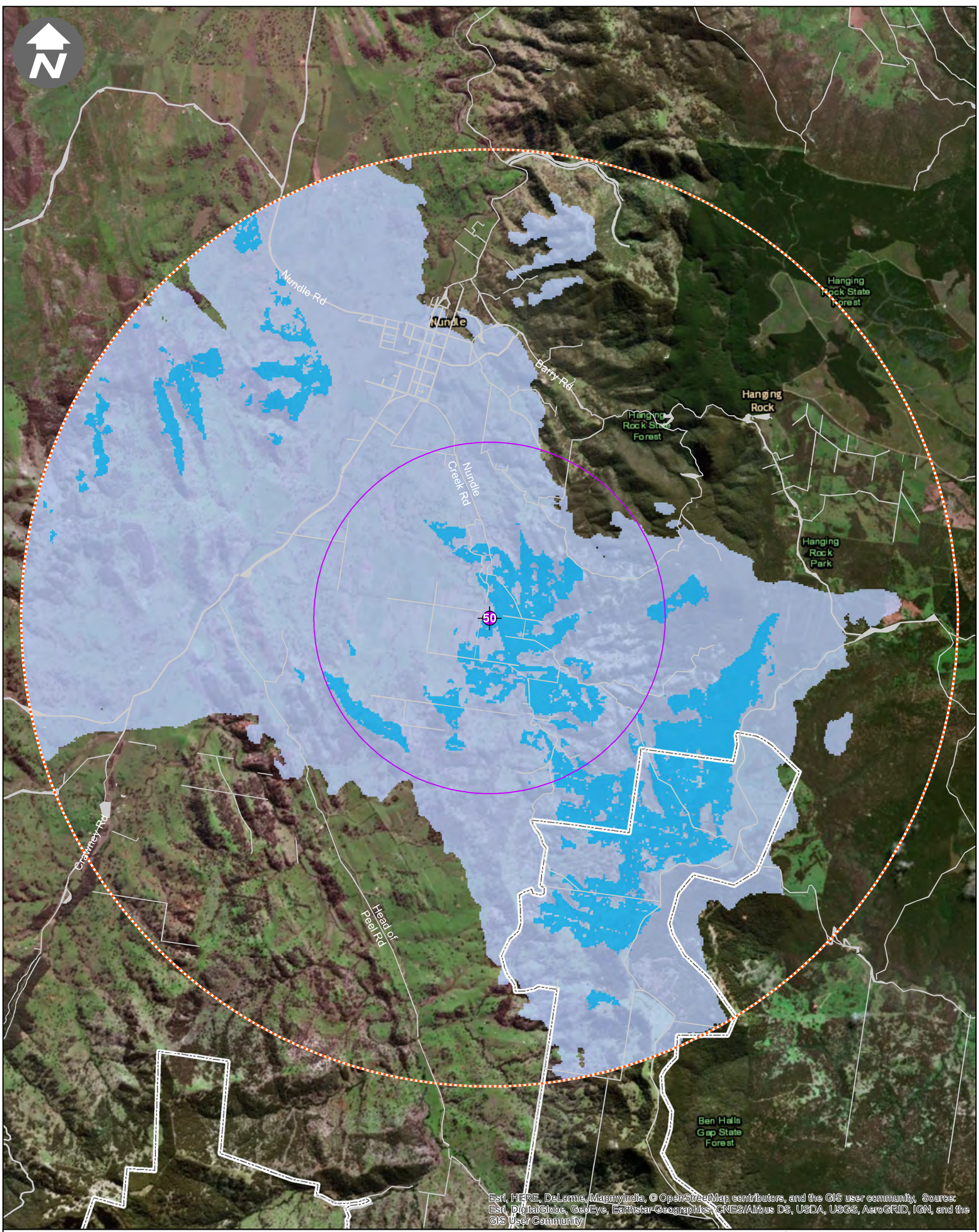
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System: **GDA 1994 MGA Zone 56**

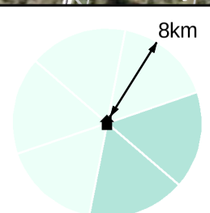
Job No	Figure No
602173-79	**NWF-5**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3415m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 50

Metres
0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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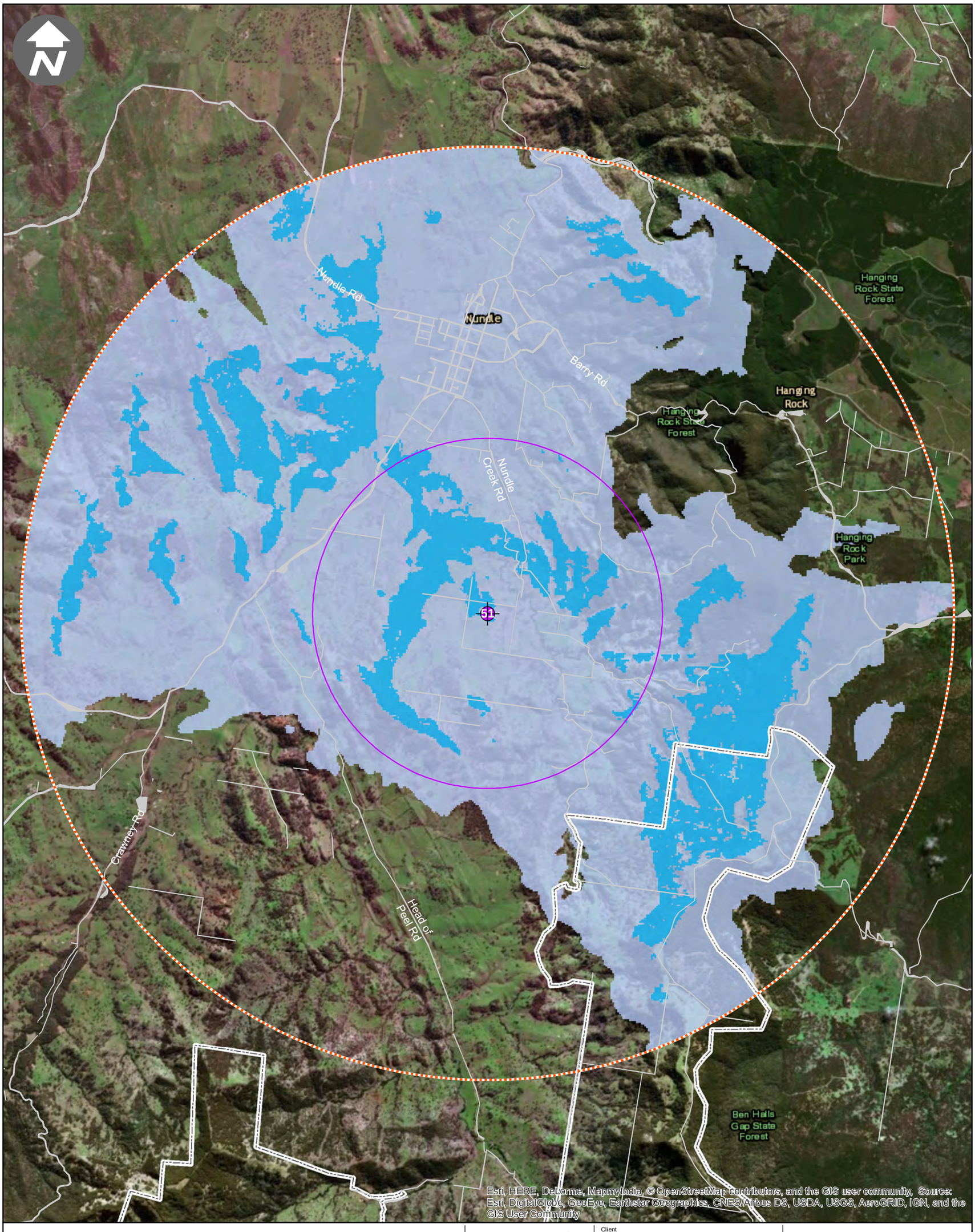
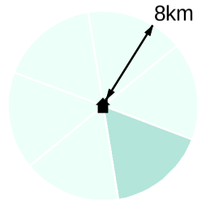
Scale at A3	Figure Status
1:60,000	**Issue**
Coordinate System	
GDA 1994 MGA Zone 56	
Job No	Figure No
602173-79	**NWF-50**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3723m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 51**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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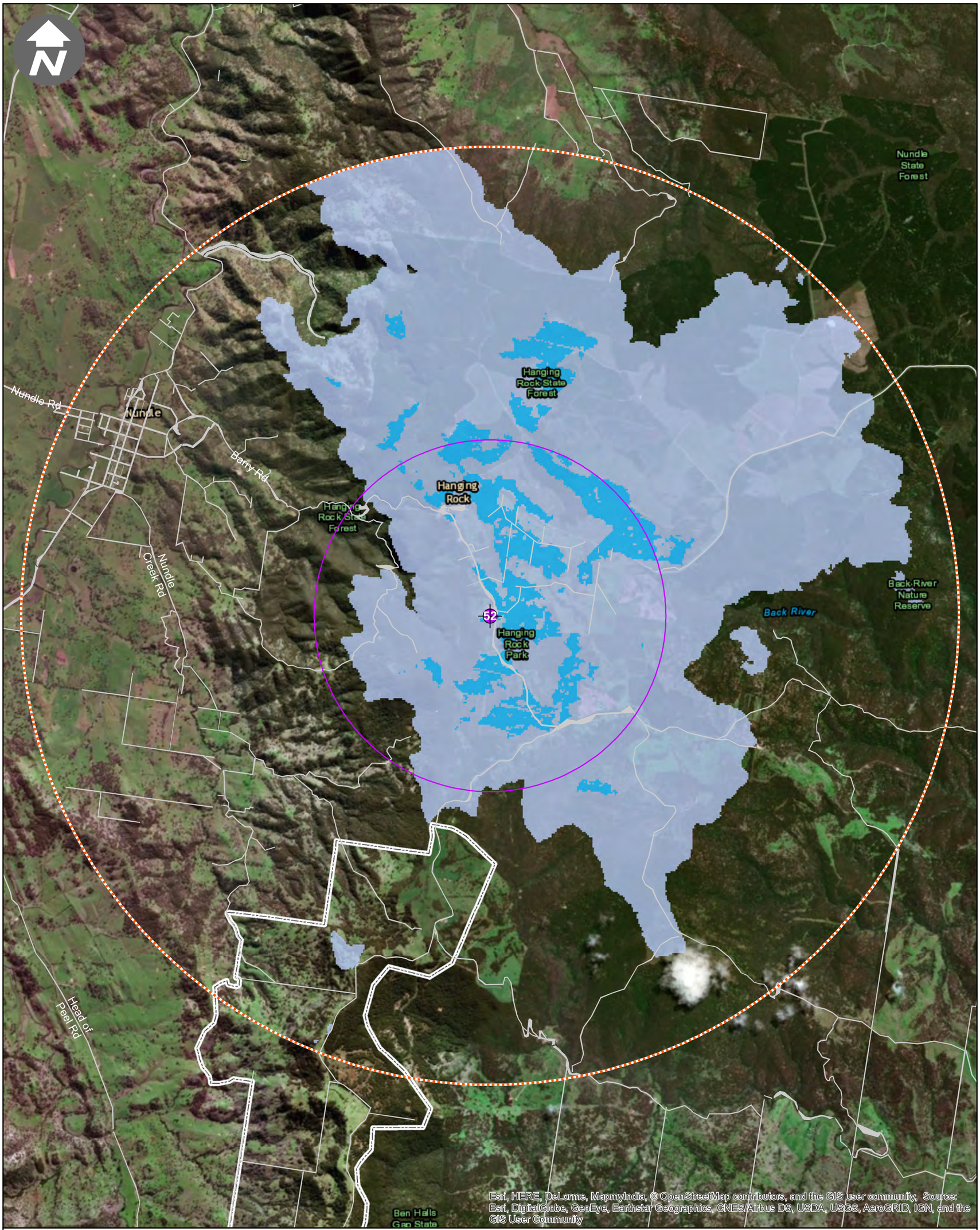
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

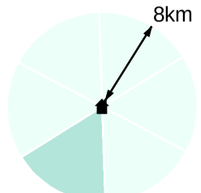
Job No	Figure No
602173-79	NWF-51



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3685m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 52**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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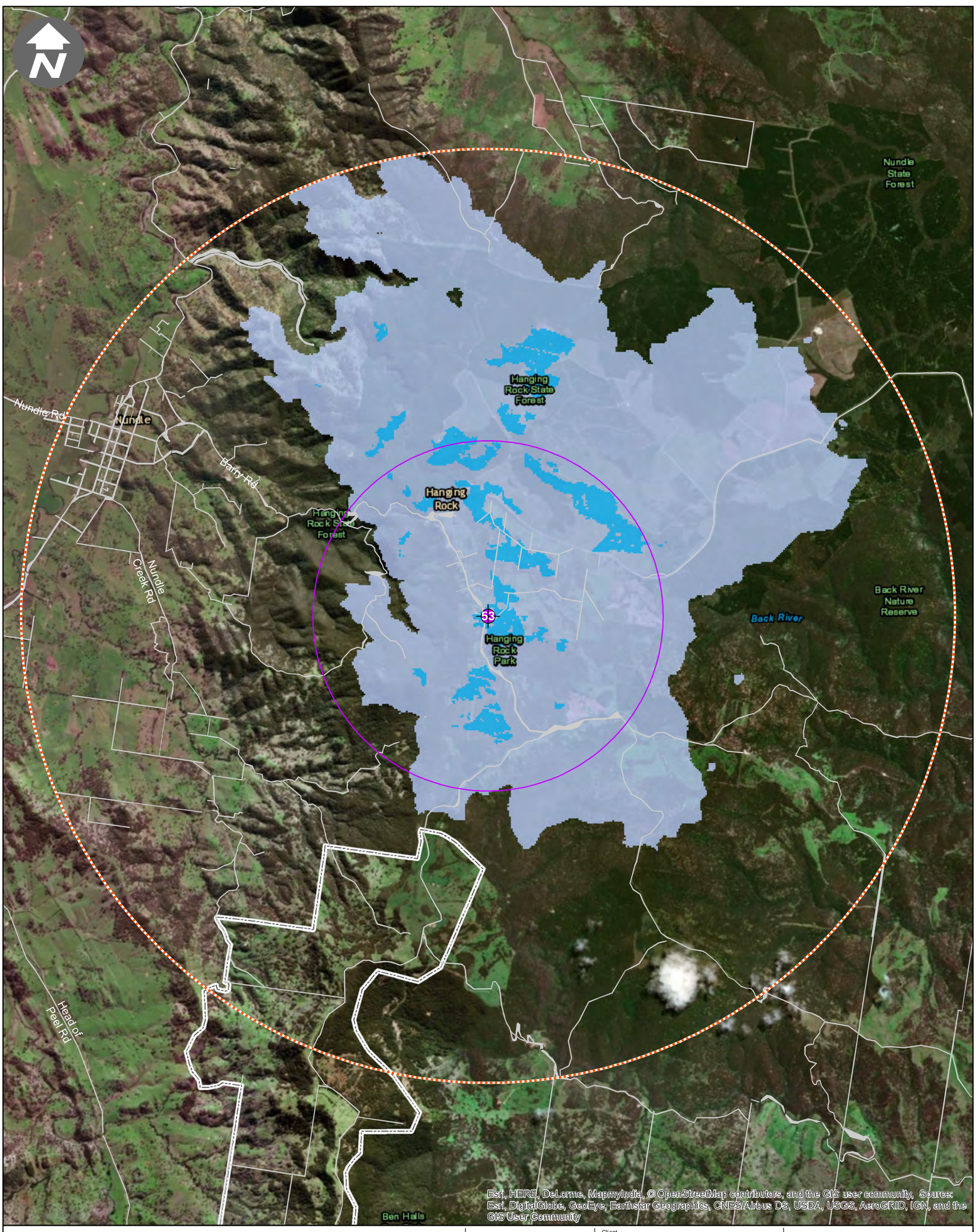
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

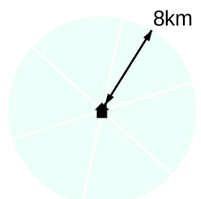
Job No	Figure No
602173-79	NWF-52



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3816m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 53**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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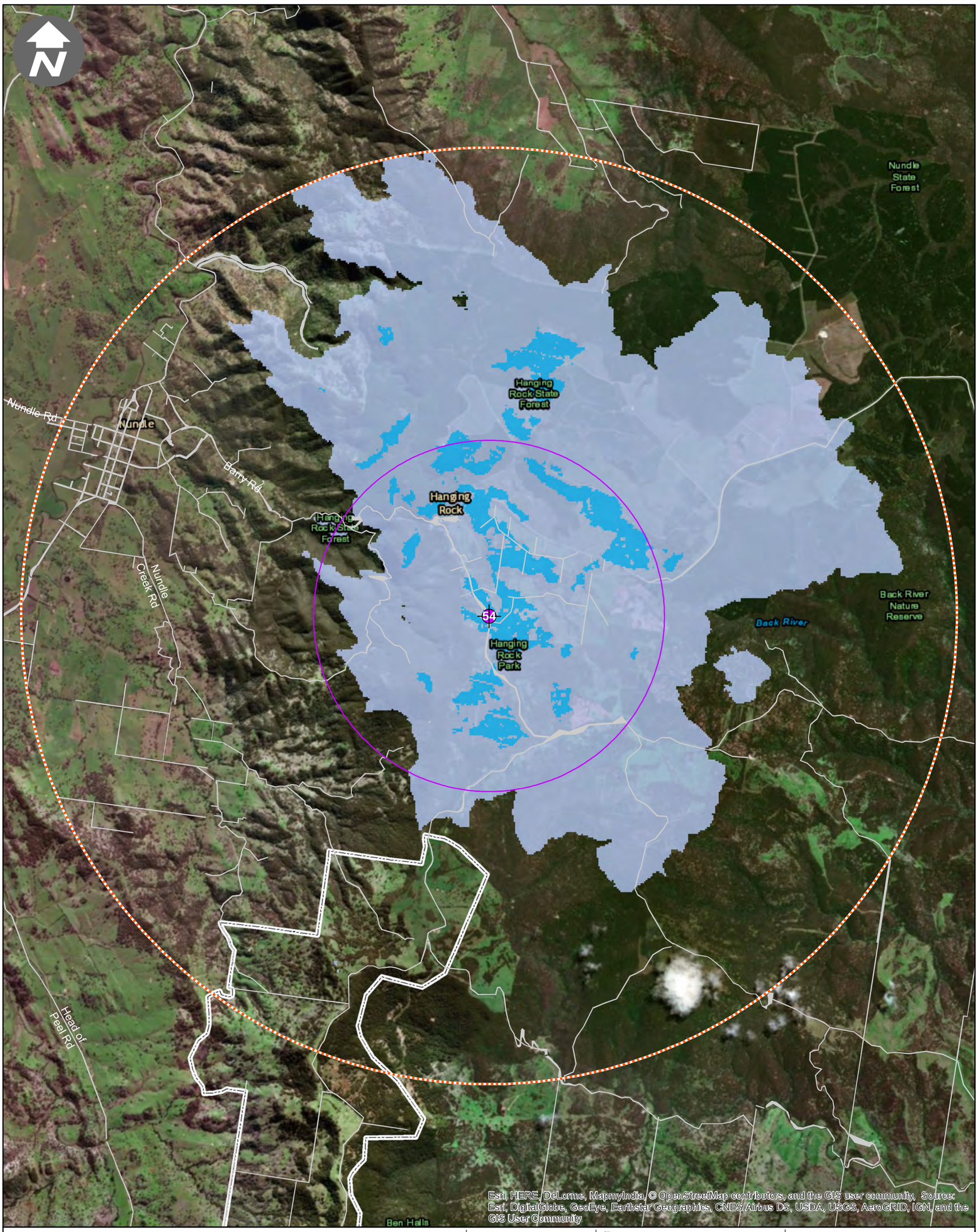
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

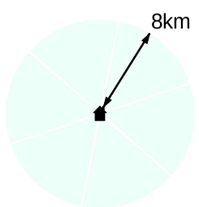
Job No	Figure No
602173-79	NWF-53



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3882m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 54**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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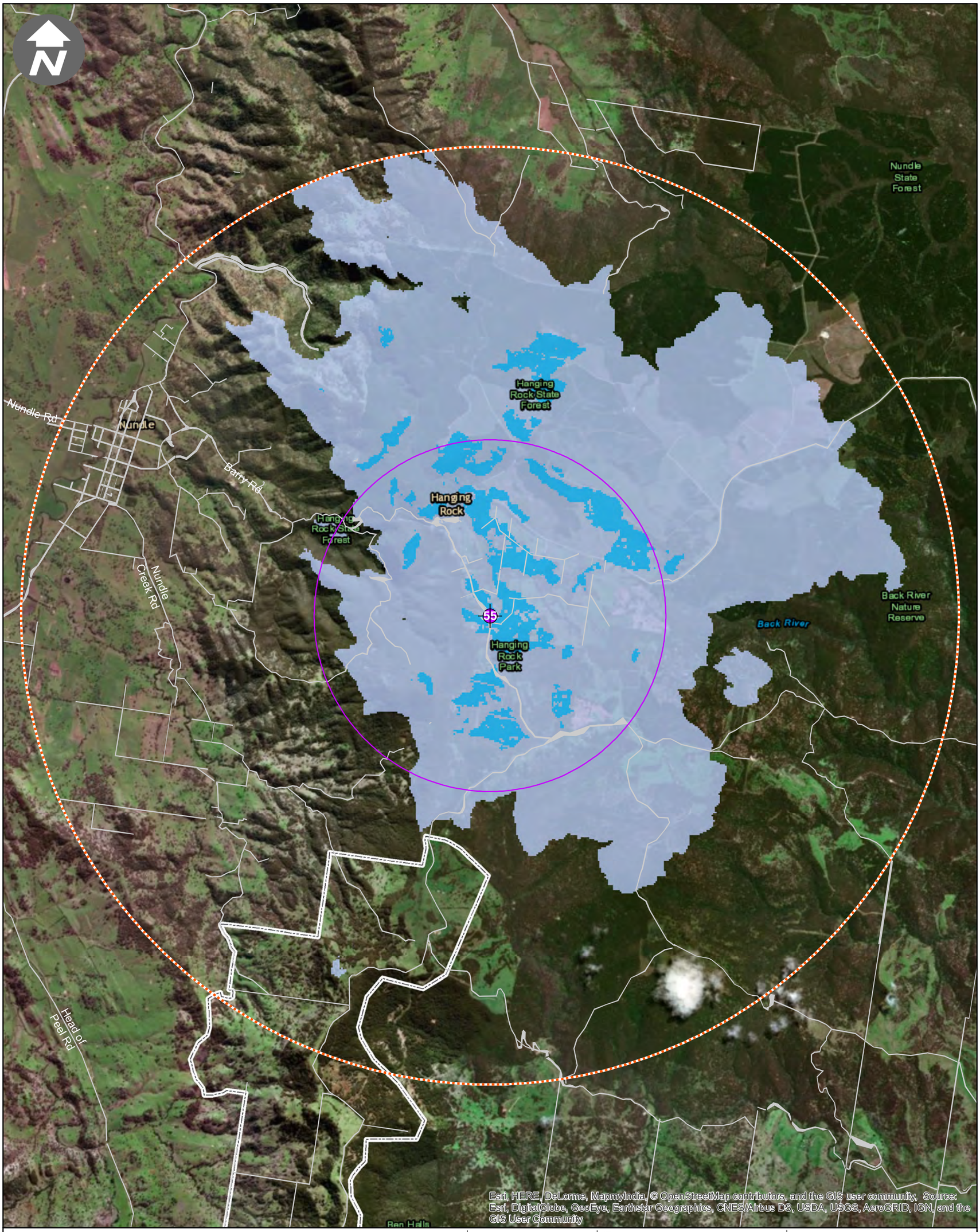
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

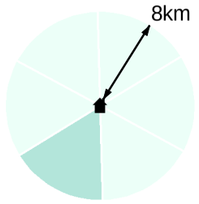
Job No	Figure No
602173-79	NWF-54



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3905m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 55**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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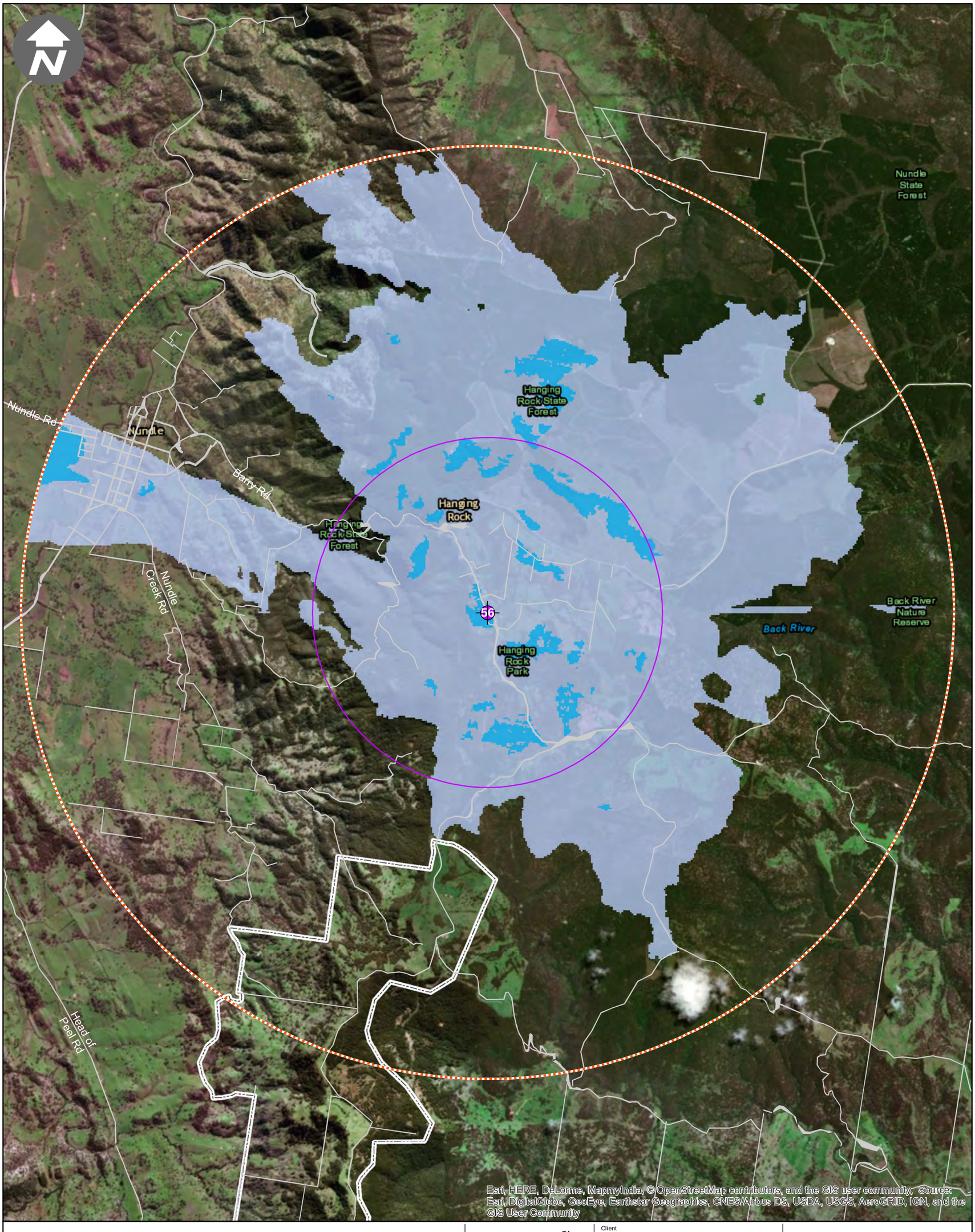
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

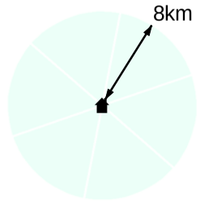
Job No	Figure No
602173-79	NWF-55



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 4016m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 56

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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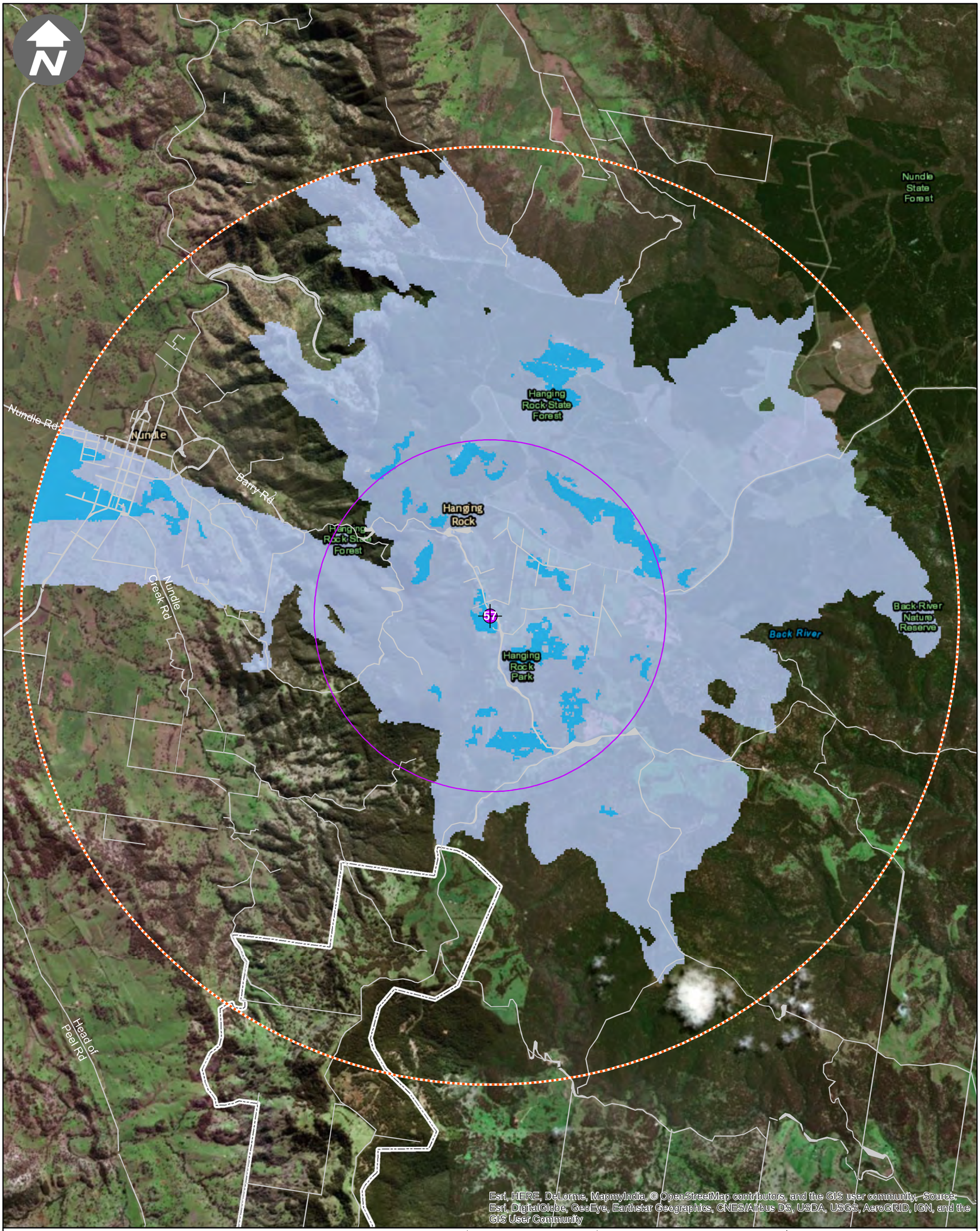
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

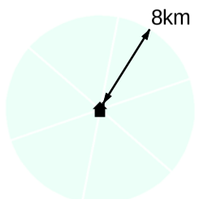
Job No	Figure No
602173-79	**NWF-56**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 4042m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 57**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

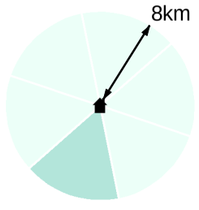
Job No	Figure No
602173-79	NWF-57

Nundle State Forest
Hanging Rock State Forest
Nundle Rd
Nundle
Barry Rd
Hanging Rock
Hanging Rock State Forest
Nundle Creek Rd
58
Back River Nature Reserve
Back River
Hanging Rock Park
Head of Peel Rd

Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 4239m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 58**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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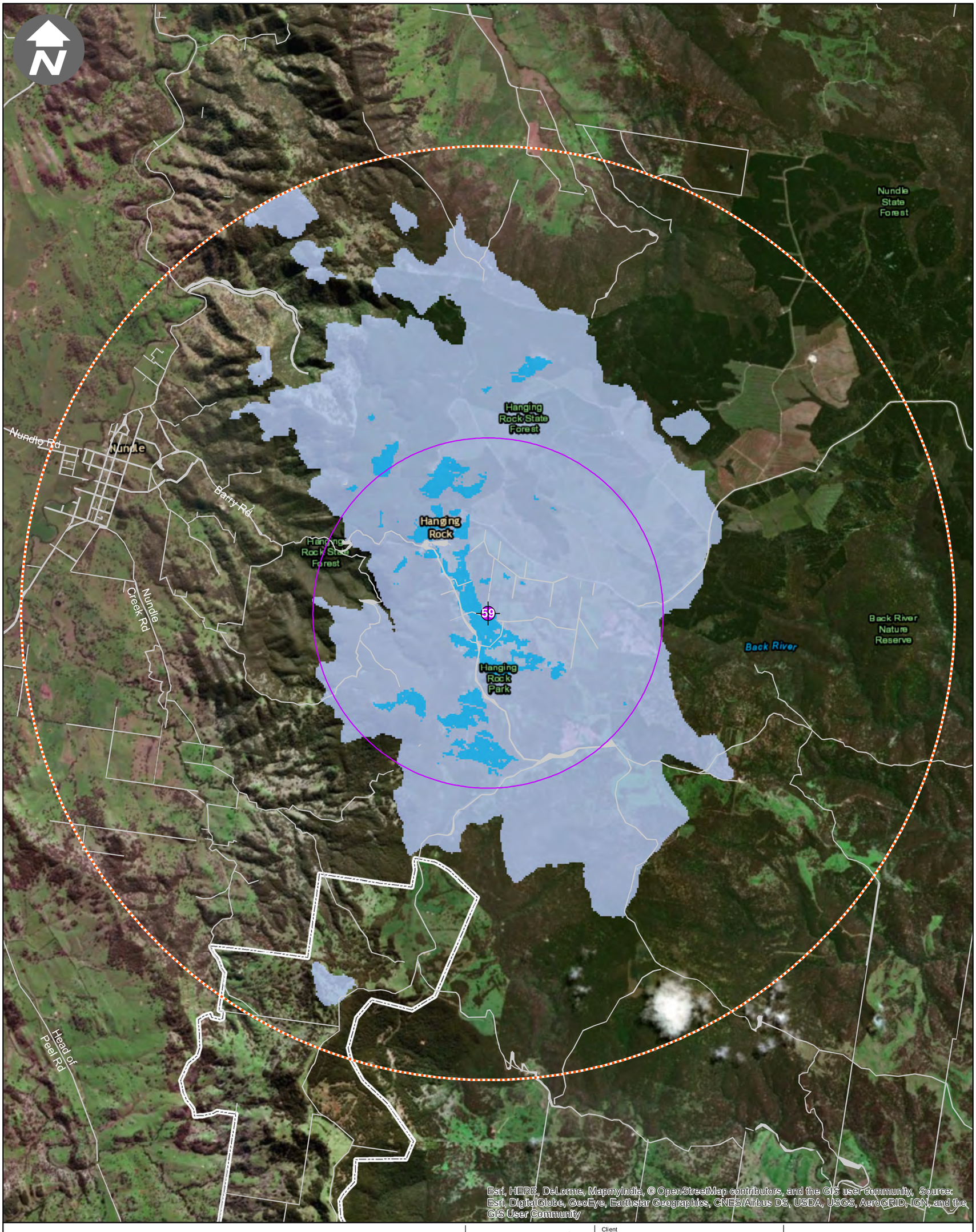
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

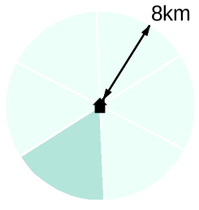
Job No	Figure No
602173-79	NWF-58



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 4361m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 59

Metres
0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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Scale at A3	Figure Status
1:60,000	**Issue**
Coordinate System	
GDA 1994 MGA Zone 56	
Job No	Figure No
602173-79	**NWF-59**

Nundle State Forest
Hanging Rock State Forest
Hanging Rock
Nundle Rd
Nundle
Barry Rd
Hanging Rock State Forest
Nundle Creek Rd
Back River Nature Reserve
Back River
Hanging Rock Park
6
Head of Peel Rd
Ben Halls Gap State Forest
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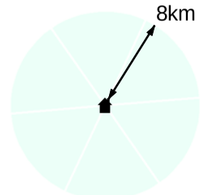
Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 2779m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 6**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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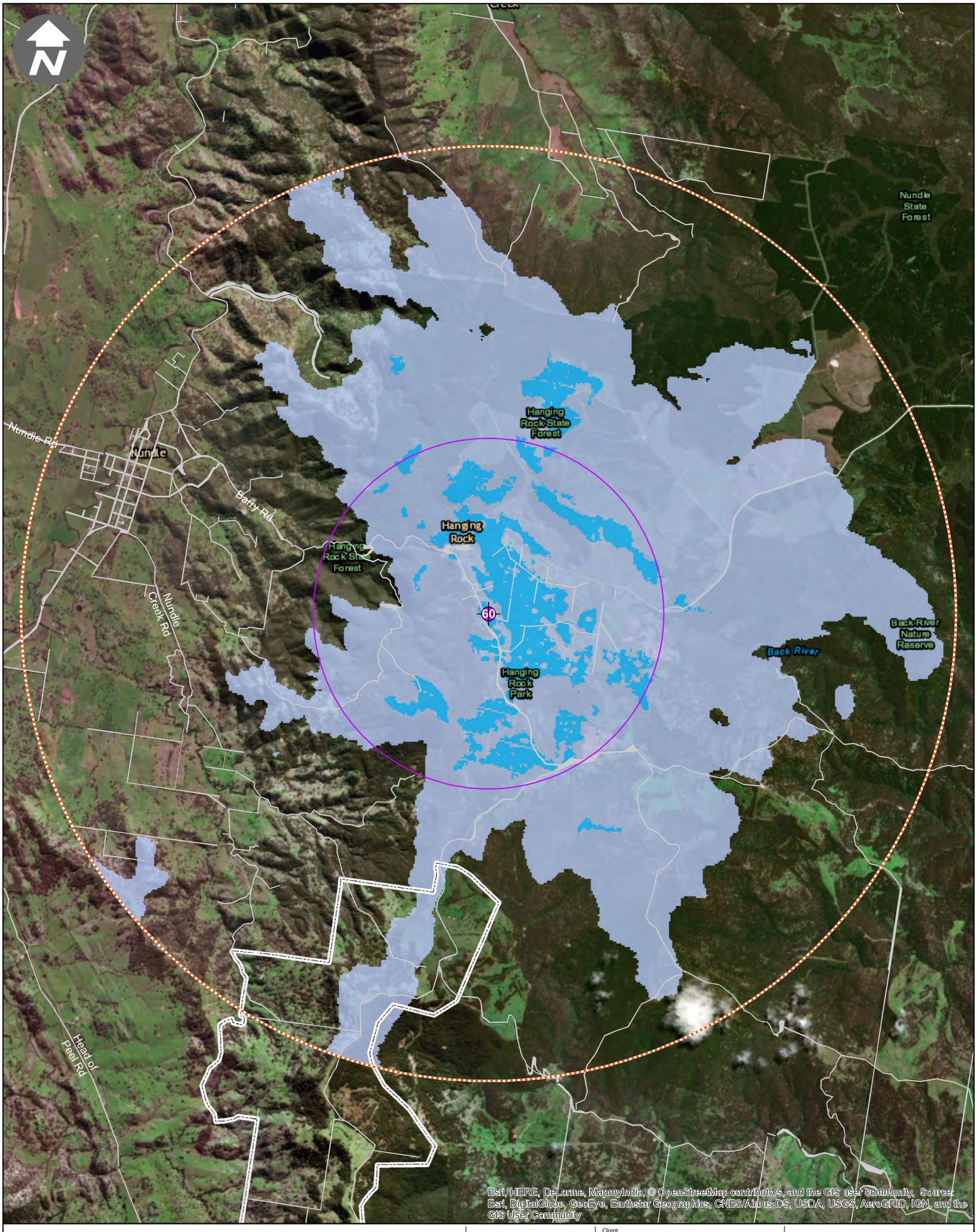
Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

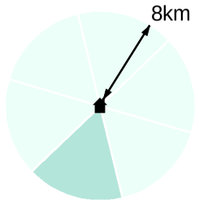
Job No	Figure No
602173-79	NWF-6



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 4362m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 60**

Metres: 0 500 1,000 1,500 2,000

D4	24/09/2018	DH	CM	CM
Issue	Date	By	Chkd	Appd

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Scale at A3	Figure Status
1:60,000	Issue

Coordinate System: **GDA 1994 MGA Zone 56**

Job No	Figure No
602173-79	NWF-60

Nundle State Forest
Hanging Rock State Forest
Nundle
Barry Rd
Hanging Rock
Hanging Rock State Forest
Nundle Creek Rd
Back River Nature Reserve
Back River
Hanging Rock Park
7
Head of Peel Rd
Ben Halls Gap State Forest
Bar (Nor
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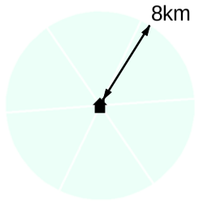
Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 2955m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 7

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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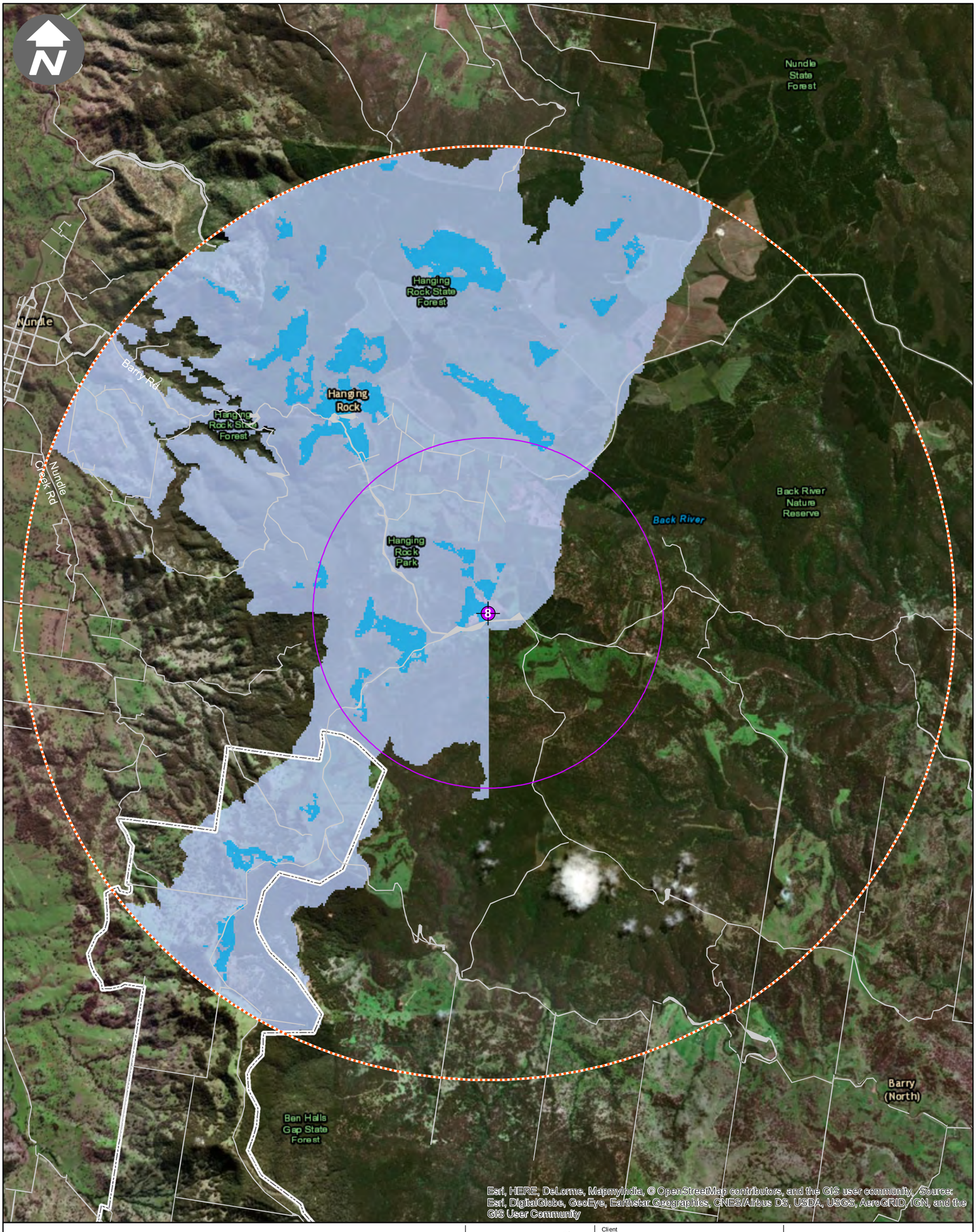
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

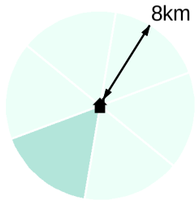
Job No	Figure No
602173-79	**NWF-7**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3080m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client
Hills of Gold Energy

Job Title
Hills of Gold Energy Project

Figure Title
Viewshed Result Property 8

Metres
0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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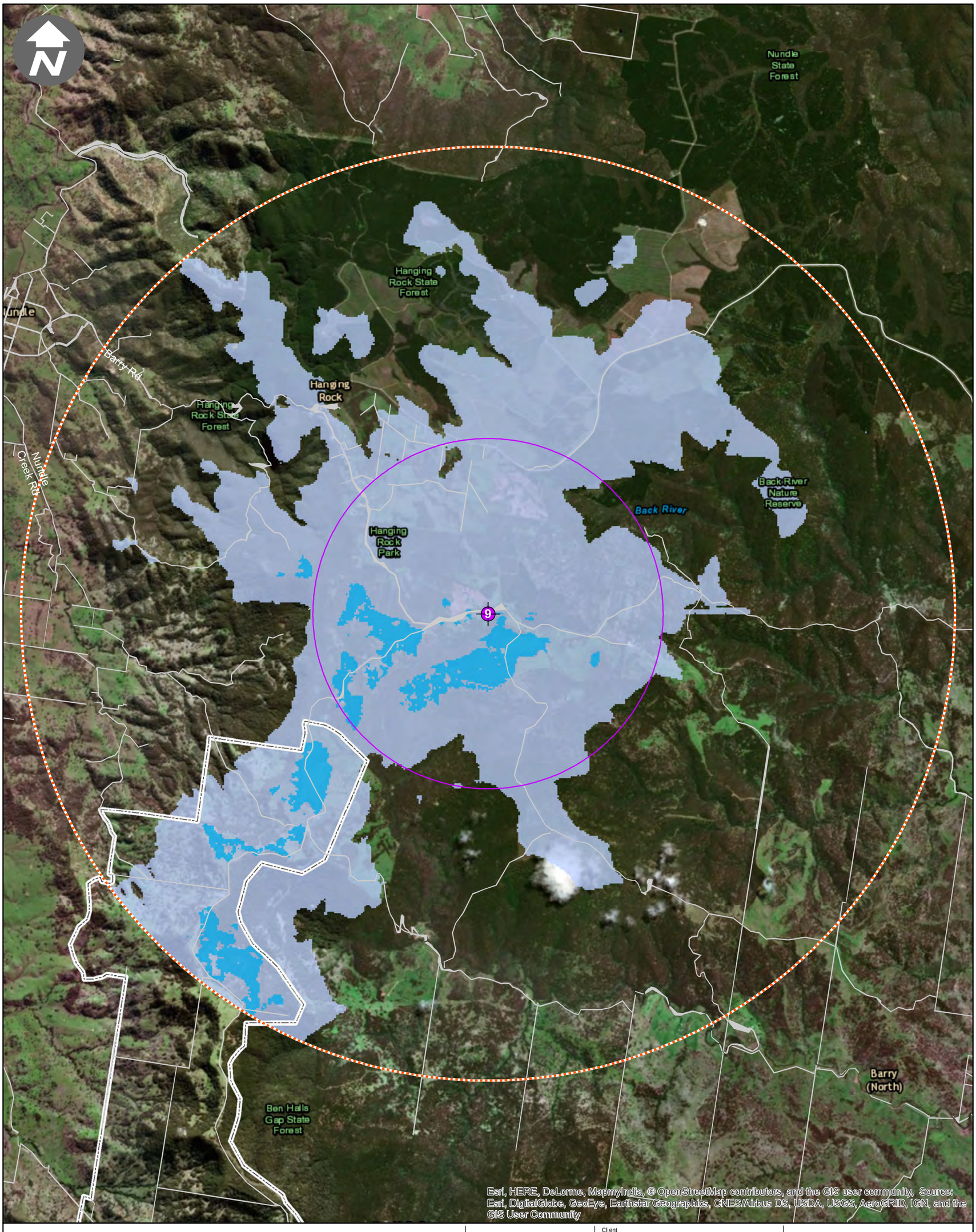
Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System
GDA 1994 MGA Zone 56

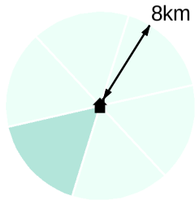
Job No	Figure No
602173-79	**NWF-8**



Legend

- Project development boundary
- Potential dwelling location
- 3km radius from dwelling
- 8km radius from dwelling
- Ground level viewshed
- 220m above ground level viewshed

NOTES:
- Ground level viewshed represents the current land theoretically visible.
- 220m above ground level viewshed represents the land where a 220m tall turbine could be theoretically be visible 8km from the dwelling.
- Distance to development boundary - 3146m.



60° sectors in which tubines in in the development boundary are potentially visible from dwelling

Client: **Hills of Gold Energy**

Job Title: **Hills of Gold Energy Project**

Figure Title: **Viewshed Result Property 9**

Metres: 0 500 1,000 1,500 2,000

Issue	Date	By	Chkd	Appd
D4	24/09/2018	DH	CM	CM

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Scale at A3	Figure Status
1:60,000	**Issue**

Coordinate System: **GDA 1994 MGA Zone 56**

Job No	Figure No
602173-79	**NWF-9**

07

Appendix B

Appendix B – 1 second DEM Metadata

Note: *This metadata describes the dataset in accordance with the ANZLIC (Australia New Zealand Land Information Council) Core Metadata Guidelines Version 2.*

Dataset citation

ANZLIC unique identifier: ANZCW0703013355
Title: 1 second SRTM Derived Digital Elevation Model (DEM) version 1.0

Custodian

Custodian: Geoscience Australia
Jurisdiction: Australia

Description

Abstract:
The 1 second Shuttle Radar Topography Mission (SRTM) derived Digital Elevation Model (DEM) Version 1.0 is a 1 arc second (~30 m) gridded DEM. The DEM represents ground surface topography, and excludes vegetation features. The dataset was derived from the 1 second Digital Surface Model (DSM; ANZCW0703013336) by automatically removing vegetation offsets identified using several vegetation maps and directly from the DSM. This product provides substantial improvements in the quality and consistency of the data relative to the original SRTM data, but is not free from artefacts. Man-made structures such as urban areas and power line towers have not been treated. The removal of vegetation effects has produced satisfactory results over most of the continent, and areas with defects are identified in the quality assessment layers distributed with the data and described in the *User Guide* (Geoscience Australia and CSIRO, 2011). A full description of the methods is in progress (Read *et al.,* in prep; Gallant *et al.,* in prep).

Smoothed DEM (DEM-S; ANZCW0703014016) was released in August 2010 as a derivative product of the DEM (and the DSM; ANZCW0703013336) and the drainage enforced version (DEM-H, ANZCW0703014615) was released in October 2011. The three products (DEM, DEM-S and DEM-H) have been released under Creative Commons licensing since October 2011.

ANZLIC search words:
LAND Topography Models
ECOLOGY Landscape

Geographic extent name: AUSTRALIA EXCLUDING EXTERNAL TERRITORIES - AUS - Australia - Australia
Geographic bounding box:
North bounding latitude: -10°
South bounding latitude: -44 °
East bounding longitude: 154°
West bounding longitude: 113°

Data currency

Beginning date: 2000-2-11
Ending date: 2000-2-22

Dataset status

Progress:
Version 1.0 of the 1 second bare-earth DEM is complete as at 23 December 2009.

Maintenance and update frequency:
Updates and revisions are anticipated to resolve some of the issues identified in the User Guide (Geoscience Australia and CSIRO, 2011) and Quality Assessment layers, and to incorporate improvements in the Digital Elevation Model.

Reference system:
Horizontal datum WGS84. Vertical datum EGM96.

Access

Stored data format:
DIGITAL - ArcGIS-grid ArcInfo grid
Available format type:
DIGITAL - ArcGIS-grid ArcInfo grid
Access constraints:

Data quality

Lineage:

Source data
1. SRTM 1 second Version 2 data (Slater *et al*., 2006), supplied by Defence Imagery and Geospatial Organisation (DIGO) as 813 1 x 1 degree tiles. Data were produced by NASA from radar data collected by the Shuttle Radar Topography Mission in February 2000.
2. GEODATA 9 second DEM Version 3 (Geoscience Australia, 2008) used to fill voids.
3. SRTM Water Body Data (SWBD) shapefile accompanying the SRTM data (Slater *et al.*, 2006). This defines the coastline and larger inland waterbodies for the DEM and DSM.
4. Vegetation masks and water masks applied to the DEM to remove vegetation.

DSM processing
This DEM is based on the 1 second SRTM derived Digital Surface Model (DSM) that was itself derived from the 1 second Shuttle Radar Topography Mission data. The DSM was produced by removing stripes, filling voids and re-flattening water bodies. Further details are provided in the DSM metadata (ANZCW0703013336).

The vegetation removal used the DSM *without* voids filled so that vegetation height estimates would not be affected by interpolated heights and so that voids adjacent to vegetated areas could be filled using bare-earth elevations.

Vegetation offset removal
The processing of vegetation offsets to produce the DEM relies on Landsat-based mapping of woody vegetation to define where the offsets are likely to occur. The mapped extents of woody vegetation were adjusted using an edge-matching process to better represent the extents of areas affected by vegetation offsets in the SRTM DSM. Vegetation was processed across approximately 40% of Australia as shown in the vegetation mask ancillary dataset and in the *User Guide* (Geoscience Australia and CSIRO, 2011).

Vegetation offset processing involves detecting vegetation patches, measuring the height offset around the edges, interpolating the height offset across the vegetated areas and subtracting the offset from the DSM. The heights of the offsets are estimated by measuring height differences across the boundaries of the vegetation patches. The method provides good estimates of the offsets in flat landscapes with well-mapped vegetation boundaries. The effect of sloping terrain is accounted for in the estimation of the offsets, but the results are less reliable in hilly terrain. Estimates of the offsets can also be very poor where the mapped vegetation extents do not match the extents of

vegetation offsets as seen by the SRTM instrument. The estimation of the vegetation offsets can also be under- or over-estimated if vegetation and topographic patterns coincide, such as trees on hilltops or dune ridges, or in inset floodplains or swamps.

The height offsets at vegetation edges are interpolated within vegetation patches to estimate the effects within the patches. The best results tend to be in small patches such as remnant tree patches. In continuously forested areas with few edges for estimating the offsets the heights are likely to be less reliable, and there is no information at all on variations of the height offset within continuous forests.
The removal of vegetation has been quite effective overall but there are many areas that contain either untreated or incompletely treated vegetation effects.

The methods will be fully described in Read, *et al.* (in prep) and Gallant, *et al.* (in prep).

Void filling
Voids (areas without data) occur in the data due to low radar reflectance (typically open water or dry sandy soils) or topographic shadowing in high relief areas. The Delta Surface Fill Method (Grohman et al., 2006) was adapted for this task, using GEODATA 9 second DEM as the infill data source. The 9 second data was refined to 1 second resolution using ANUDEM 5.2 without drainage enforcement. Delta Surface Fill Method calculates height differences between SRTM and infill data to create a 'delta' surface with voids where the SRTM has no values, then interpolates across voids. The void is then replaced by infill DEM adjusted by the interpolated delta surface, resulting in an exact match of heights at the edges of each void. Two changes to the Delta Surface Fill Method were made: interpolation of the delta surface was achieved with natural neighbour interpolation (Sibson, 1981; implemented in ArcGIS 9.3) rather than inverse distance weighted interpolation; and a mean plane inside larger voids was not used.

Water bodies
Water bodies defined from the SRTM Water Body Data as part of the DSM processing were set to the same elevations as in the DSM.

Edit rules for land surrounding water bodies
SRTM edit rules set all land adjacent to water at least 1 m above water level to ensure containment of water (Slater *et al*., 2006). Following vegetation removal, void filling and water flattening, the heights of all grid cells adjacent to water were set to at least 1 centimetre above the water surface. The smaller offset (1 cm rather than 1 m) could be used because the cleaned digital surface model is in floating point format rather than integer format of the original SRTM.

Some small islands within water bodies are represented as voids within the SRTM due to edit rules. These voids are filled as part of void filling process, and their elevations set to a minimum of 1 cm above surrounding water surface across the entire void fill.

Overview of quality assessment
The quality of vegetation offset removal was manually assessed on a 1/8 ×1/8 degree grid. Issues with the vegetation removal were identified and recorded in ancillary data layers. The assessment was based on visible artefacts rather than comparison with reference data, and relies on the detection of artefacts by edges.

The issues identified were:
- vegetation offsets are still visible (not fully removed)
- vegetation offset over-estimated
- linear vegetation offset not fully removed
- incomplete removal of built infrastructure and other minor issues

DEM ancillary data layers
The vegetation removal and assessment process produced two ancillary data layers:
- A shapefile of 1/8 × 1/8 degree tiles indicating which tiles have been affected by vegetation removal and any issue noted with the vegetation offset removal

- A difference surface showing the vegetation offset that has been removed; this shows the effect of vegetation on heights as observed by the SRTM radar instrument and is related to vegetation height, density and structure.

The water and void fill masks for the 1 second DSM were also applied to the DEM. Further information is provided in the *User Guide* (Geoscience Australia and CSIRO, 2011).

Positional accuracy:

The horizontal positional error is the same as for the raw SRTM 1 second data, with 90% of tested locations within 7.2 m for Australia. See Rodriguez *et al.* (2006) for more information.

Attribute accuracy:

Accuracy was tested on the 1 second DEM using 1198 Permanent Survey Marks distributed across the Australian continent relative to the Australian Height Datum (AHD71). Results of this comparison show the absolute accuracy of the data as tested relative to AHD71 to be 7.582 m at the 95th percentile with a RMS error of 3.868 in open, flat terrain. Ninety-nine percent of points are within a height difference of less than 9.602 m.

The removal of striping artefacts improves the representation of the landform shape, particularly in low relief areas, but it is not clear whether this also produces an improvement in overall height accuracy. Some striping remains in the data at a much reduced level (mostly less than 0.3 m amplitude). Additional artefacts including long-wavelength (~10km) striping have not been corrected.

The removal of vegetation offsets provides a significant improvement in the representation of the landform shape, particularly in low relief areas, and areas of remnant vegetation. Elevation accuracy varies in forested areas. Comparisons with several higher resolution datasets suggest that elevation accuracy varies, depending on the height and structure of the existing vegetation, quality of vegetation input masks and local relief. Further details of these comparisons are provided in the *User Guide* (Geoscience Australia and CSIRO, 2011).

Height accuracy is likely to be poorer in areas where voids have been filled using the GEODATA 9 second DEM, particularly in high relief areas.

Logical Consistency:

The DEM represents heights of the land surface. Due to random noise, the relative elevation between adjacent grid cells can be in error by several m.

The removal of vegetation involves estimation of vegetation height at the edges of vegetation patches, and interpolation of those heights across areas of continuous vegetation cover. Variations in vegetation height within large areas of vegetation are not captured by this method. The vegetation removal process guarantees that no elevations have been increased as part of the process.

All void areas have been filled and there are no discontinuities due to tile boundaries.

The SRTM editing rules relating to water bodies have been respected in the processing: lakes are flat, rivers descend continuously in a downstream direction and sea surfaces are at 0 m elevation. Flattened water bodies occupy the same areas as in the original SRTM 1 second data. Grid cells adjacent to water bodies are at least 1 cm above the water surface. Void areas within water bodies (small islands not represented in the original SRTM data) are at least 1 cm above the water surface over their entire area.

Completeness:

The DEM covers all of continental Australia and near coastal islands, with land areas including all islands defined by the available SRTM 1 second elevation and SRTM Water Body Data datasets.

The following tiles containing fragments of mainland or pieces of islands were not supplied at 1 second resolution and are therefore missing from the DEM:

E112 S26	E124 S15	E142 S10
E113 S29	E125 S14	E143 S10
E118 S20	E132 S11	E146 S17
E120 S35	E133 S11	E150 S22
E121 S35	E134 S35	E152 S24
E123 S16	E141 S10	

Note that the coordinates are of the south-western corner of the tile.

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Metadata information

Metadata Created date: 2009-12-23
Metadata Updated date: 2010-08-30
Metadata Updated date: 2011-09-01

Additional metadata

Conversion to floating point format
As a by-product of the de-striping process the integer data was converted to floating point format to allow for the continuously varying nature of the striping. Areas where no de-striping was required will contain unaltered integer values, but are represented in floating point format for consistency.

Data layers distributed with the data
Four additional data layers provide information about the alterations made to the raw SRTM data to produce this DEM:

- A water mask at 1 second resolution showing the cells that are part of the flattened water bodies
- A void mask showing cells that were no-data in the raw SRTM and have been filled using the void filling algorithm
- Vegetation masks at 1/8 × 1/8 degree resolution, illustrating where vegetation was removed from the DEM and issues noted with the removal
- Tile indexes for the DEM

References

Gallant, J.C., Read, A.M., Dowling, T.I. and Austin, J.M. (in prep) Removing vegetation offsets from the 1 second SRTM DEM for Australia.

Geoscience Australia (2008) GEODATA 9 Second DEM Version 3

Geoscience Australia and CSIRO (2011) 1 Second SRTM Derived Digital Elevation Models User Guide. Version 1.0. Geoscience Australia.

Grohman, G., Kroenung, G., and Strebeck, J. (2006) Filling SRTM voids: The delta surface fill method. Photogrammetric Engineering and Remote Sensing 72 (3), 213-216.

Read, A.M., Gallant, J.C. and Dowling, T.I. (in prep) Destriping and void filling methods used in the 1 second SRTM DEM for Australia.

Rodríguez, E., Morris, C.S., and Belz, J.E. (2006) A global assessment of the SRTM performance. Photogrammetric Engineering and Remote Sensing 72 (3), 249-260.

Sibson, R. (1981) A brief description of natural neighbour interpolation. In V. Barnet, editor, Interpreting Multivariate Data, pages 21-36. John Wiley & Sons, Chichester.

Slater, J.A., Garvey, G., Johnston, C., Haase, J., Heady, B., Kroenung, G., and Little, J. (2006) The SRTM data "finishing" process and products. Photogrammetric Engineering and Remote Sensing 72 (3), 237-247.

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