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# Gullen Solar Farm

# Construction & Operational Noise Impact Assessment

Report Number 640.10935-R1

16 May 2016

Goldwind

Version: Revision 5

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# Construction & Operational Noise Impact Assessment

PREPARED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
Suite 6, 131 Bulleen Road
Balwyn North VIC 3104 Australia

T: +61 3 9249 9400 F: +61 3 9249 9499
melbourne@slrconsulting.com www.slrconsulting.com



## DOCUMENT CONTROL

| Reference | Status | Date | Prepared | Checked | Authorised |
|---|---|---|---|---|---|
| 640.10935-R1 | Revision 5 | 16 May 2016 | Ima Fricker | Gustaf Reutersward | Gustaf Reutersward |
| 640.10935-R1 | Revision 4 | 6 May 2016 | Ima Fricker | Gustaf Reutersward | Gustaf Reutersward |
| 640.10935-R1 | Revision 3 | 14 January 2016 | Ima Fricker | Gustaf Reutersward | Gustaf Reutersward |
| 640.10935-R1 | Revision 2 | 17 December 2015 | Ima Fricker | Gustaf Reutersward | Gustaf Reutersward |
| 640.10935-R1 | Revision 1 | 15 December 2015 | Ima Fricker | Gustaf Reutersward | Gustaf Reutersward |
| 640.10935-R1 | Revision 0 | 11 November 2015 | Ima Fricker | Gustaf Reutersward | Gustaf Reutersward |

# Executive Summary

SLR Consulting Australia Pty Ltd (SLR) was commissioned by NGH Environmental Pty Ltd on behalf of Goldwind (Australia) Pty Ltd, to undertake a Construction and Operation Noise Impact Assessment for the proposed 10 MW Gullen Solar Farm located in Bannister, southeast NSW.

Goldwind are seeking to build the development to complement existing electricity generation and distribution infrastructure located on site as part of the existing operational Gullen Wind Farm. Whilst full details of the project are not currently available, general information regarding construction staging, operational requirements and site layout are available and sufficient to undertake the required assessments.

The previous assessment contained in SLR Report 640.10935-R1R3, dated 15 January 2016 allowed for a larger 11 MW capacity. However, following the review process it is understood that the solar farm layout has since been revised with the following major changes:

- The cluster of solar panels located approximately 200 m to 800 m from the western site boundary has been removed (i.e. the bulk of the solar panels and inverters are located central / to the eastern side of the site).
- There are now 4x larger capacity (quieter) 2.5 MW inverters to allow for a total solar farm capacity of 10 MW (as compared to the initial arrangement which allowed for up to 6 locations with 2x 1000 kW inverters co-located at each site.)

The results of the updated noise impact assessment indicate that noise during the various construction phases of the facility will result in minimal noise impacts to the surrounding community.

Once the solar farm is operational, it is likely that noise from the solar farm will be inaudible at all surrounding receptors and easily comply with applicable INP requirements.

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# 1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR Consulting) has been retained by NGH Environmental Pty Ltd (NGH) on behalf of Goldwind Australia Pty Ltd (Goldwind) to prepare a Construction and Operational Noise Impact Assessment of the proposed Gullen Solar Farm in southeast New South Wales.

Specific acoustic terminology is used within this report. An explanation of common terms is included in **Appendix A**.

## 1.1 Objectives

The objectives of this study were to:

1. Establish noise level design goals (criteria) for environmental noise emissions at potentially noise affected sensitive receivers surrounding the site.
2. Determine all acoustically significant plant required for the construction and operation of the facility to predicted noise at the nearest potentially affected noise sensitive receivers within the vicinity of the solar farm.
3. From results of the noise predictions, assess noise levels from proposed construction and future operations relative to the noise criteria at the nearest potentially affected receivers.

## 1.2 Relevant Guidelines

The noise and vibration guidelines for construction and operations are based on the publications managed by the New South Wales (NSW) Environment Protection Authority (EPA). The EPA guidelines applicable to this assessment include:

- Construction Noise – *Interim Construction Noise Guideline* (DECC 2009).
- Operational Noise – *Industrial Noise Policy* (OEH 2000).

# 2 PROJECT OVERVIEW

The proposed 10 MW (AC) solar farm is anticipated to produce approximately 22,000 MWh per annum which is enough to supply electricity for approximately 3,160 homes.

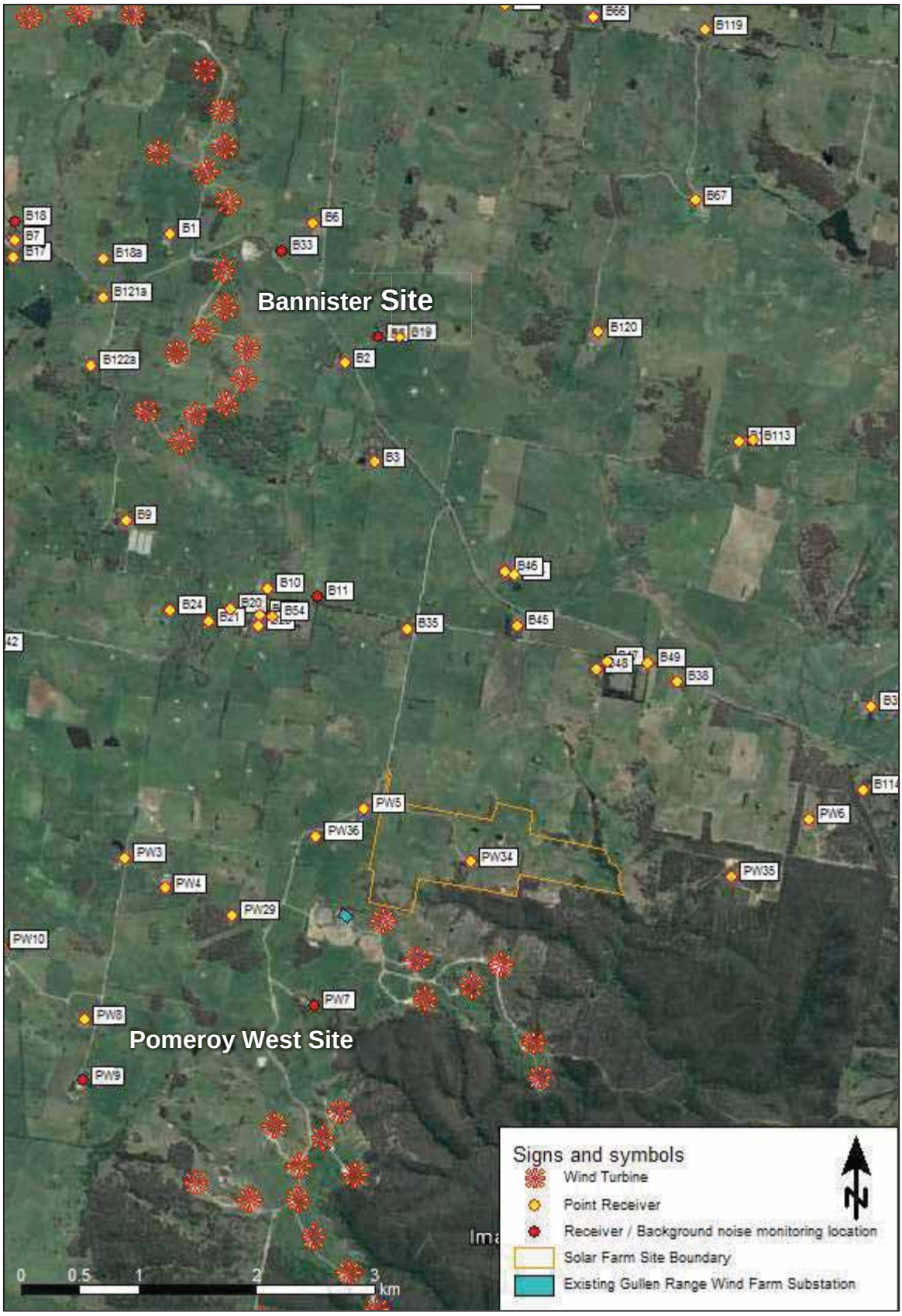
The solar farm has been specifically sited to make use of existing electricity generation and transmission infrastructure associated with the operational Gullen Range Wind Farm.

Wind and solar energy generation profiles are seen as extremely compatible as wind farms often generate a greater percentage of energy at night with the associated substations often having spare capacity. This fits well with solar generation which is a better match to daytime electricity requirements, especially in summer when electricity usage peaks due to air-conditioning demand.

## 2.1 Project Location

The development site is at No.: 131 Storriers Lane, Bannister (1/DP119622) which is located to the north of the Pomeroy precinct boundary for the Gullen Range Wind Farm project; approximately 12 km south of Crookwell, and 15 km northwest of Goulburn. **Figure 1** on the following page shows the site of the proposed solar farm relative to the existing wind farm power generation and distribution infrastructure and surrounding residential dwellings. It is noted that the naming convention used for the assessment of the Gullen Range Wind Farm has been used to maintain consistency.

**Figure 1 Site Overview – Solar Farm Location relative to Existing Wind Farm Infrastructure**

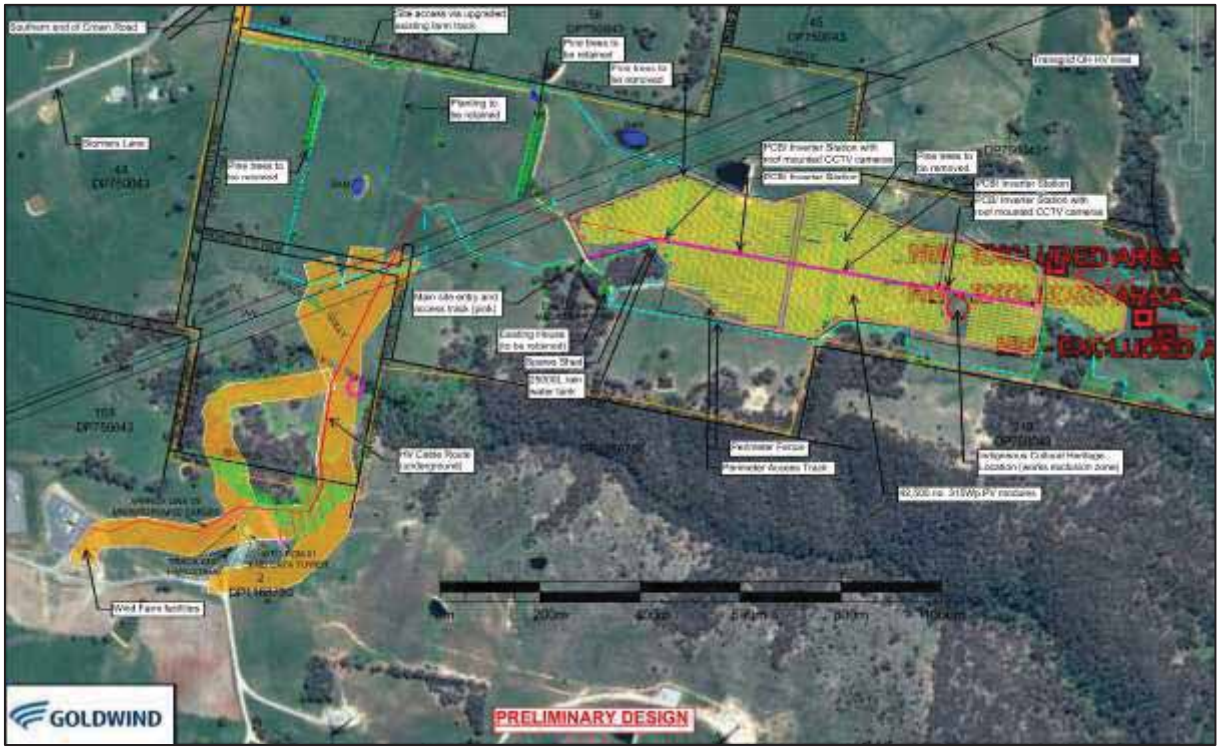


## 2.2 Proposed Layout

The Gullen Solar Farm is anticipated to occupy approximately 25 hectares. This area of land has been acquired by Goldwind and earmarked for the construction and operation of the solar farm.

The design layout as provided by the proponent is presented in **Figure 2**.

**Figure 2 Indicative Layout of Gullen Solar Farm**




Note: Image from document Goldwind drawing Ref: XXX-G-GAD-01B, dated 17 February 2016

## 2.3 Proposed Infrastructure for Solar Farm

A description of the likely infrastructure required for the operation of the solar farm is provided in the Statement of Environmental Effects (SEE) document prepared by NGH.

The key infrastructure components of the proposal include:

- Approximately 40,000 solar panel (photovoltaic / PV) modules (indicative module size 992 mm by 1956 mm), standing up to 2 m high.
- Panel support frames, supported by posts either driven or concreted into the ground.
- 1 kV to 1.5 kV junction boxes.
- 4 x 2.5 MW inverters and step up transformers (to allow for a total capacity of 10 MW), to convert direct current (DC) electricity produced by the solar panel modules into alternating current (AC) capable of being connected to the existing electrical substation.
- Up to 3 km of 33 kV underground reticulation (cabling to the existing substation).
- 33 kV switchgear (to allow connection to the existing substation).
- Minor earthworks.

- Access roads up to 4 m wide, north of the site and allowing access to the substation, south-west of the site.
- A central control and monitoring system.

### 2.3.1 Power generation

The PV modules would be connected in series to form strings and then the strings would be connected together in parallel into inverters. The inverters convert DC output from the PV modules into AC. Medium voltage transformers step up the AC output from the inverters, and then the power would be transmitted to the project substation (existing as part of the wind farm development). At the substation an existing high voltage transformer would step up the voltage to 330 kV, for connection into the grid.

### 2.3.2 Transmission

The project would be connected to the electricity grid via the existing Wind Farm substation and Transgrid Gullen switching station.

## 2.4 Construction

Construction of the proposed solar farm would be completed in the following stages:

- Pre-construction and site investigations, such as geotechnical assessment to inform how the panels are mounted and secured
- Detailed design and procurement of materials
- Site establishment and preparation for construction, including fencing, earthworks, set out and construction of access roads and sediment and erosion controls
- Delivery of materials and equipment
- Installation of the foundations or driven piles
- Installation of underground cabling
- Assembly of the panel frames and mounts
- Installation of the Inverter / transformer units
- Installation of low voltage cabling.
- Substation works to connect the solar farm to the existing substation (these occur within the switch room with no additional visible external substation infrastructure required)
- Testing and commissioning of the solar farm
- Removal of temporary construction facilities and completion of restoration works

# 3 NSW REGULATORY GUIDELINES

## 3.1 NSW Construction Noise Guidelines

Noise from construction works in NSW is subject to the provisions of the NSW EPA (formerly the Department of Environment & Climate Change (DECC)) document *'Interim Construction Guideline'*, dated July 2009 (ICNG).

The main objectives of the guideline are stated in Section 1.3, a portion of which is presented below:

- Promote a clear understanding of ways to identify and minimise noise from construction works.
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts.
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours.

The guideline sets out Noise Management Levels (NMLs) at residences, and how they are to be applied, as presented in **Table 1**.

This approach intends to provide respite or residents exposed to excessive construction noise outside the recommended standard hours whilst allowing construction during the recommended standard hours without undue constraints.

**Table 1 ICNG - Quantitative NML Criteria for Construction Noise at Residences**

| Time of Day | Management Level $L_{Aeq}$[1](15minute) | How to Apply |
|---|---|---|
| Recommended standard hours:<br><br>Monday to Friday<br>7.00 am to 6.00 pm<br><br>Saturday<br>8.00 am to 1.00 pm<br><br>No work on Sundays or public holidays | Noise affected<br>RBL[2] + 10 dBA[5] | The noise affected level represents the point above which there may be some community reaction to noise.<br>Where the predicted or measured $L_{Aeq(15minute)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise.<br>The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details. |
| | Highly noise affected<br>75 dBA | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level.<br>If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided. |
| Outside recommended standard hours | Noise affected<br>RBL + 5 dBA | A strong justification would typically be required for works outside the recommended standard hours.<br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community. |

[1] $L_{Aeq}$ The A-weighted equivalent continuous noise level. It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound (typically over a 15 minute period). The parameter is commonly used to quantify and assess noise impacts.

[2] RBL Rating Background Level, the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-h period used for the Assessment Background Level (ABL[3]), The RBL is the level used for assessment purposes. It is defined as the median value of all the ABL's for the assessment period.

[3] ABL Assessment Background Level, the single-figure background level representing each assessment period. It is defined as the lower tenth percentile of the background $L_{A90}$[4] noise levels measured during the assessment period for each day.

[4] $L_{A90}$ The A-weighted noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

[5] dBA The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an "A-weighting" filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

## 3.2 Operational Noise

Responsibility for the control of noise emission in New South Wales is vested in Local Government and the Environmental Protection Authority (EPA). The Industrial Noise Policy (INP) which was released in January 2000 provides a framework and process for deriving noise criteria for consents and licences that will enable the EPA to regulate premises that are scheduled under the Protection of the Environment Operations Act, 1997.

The specific policy objectives are to:

- To establish noise criteria that would protect the community from excessive intrusive noise and preserve amenity for specific land uses.
- To use the criteria as the basis for deriving project specific noise levels.
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.
- To outline a range of mitigation measures that could be used to minimise noise impacts.
- To provide a formal process to guide the determination of feasible and reasonable noise limits for consents or licences that reconcile noise impacts with the economic, social and environmental considerations of industrial development.
- To carry out functions relating to the prevention, minimisation and control of noise from the premises scheduled under the Act.

### 3.2.1 Assessing Intrusiveness

For assessing intrusiveness, the background noise level must be measured to determine the resultant RBL for each period. The intrusiveness criterion essentially means that the equivalent continuous noise level ($L_{Aeq}$) from the source should not be more than five decibels above the measured background noise level (RBL) at the sensitive location.

### 3.2.2 Assessing Amenity

The amenity assessment is based on noise criteria specific to land use and associated activities. The criteria relate only to industrial-type noise and do not include road, rail or community noise.

Where there is no existing noise from industry in the receiver area the applicable amenity criteria are determined based on the Acceptable Noise Level (ANL) for the receiver type in accordance with INP methodology (see **Table 2** on the following page).

**Table 2 INP Amenity Criteria – Recommended $L_{Aeq}$ noise levels from industrial noise sources**

| Type of Receiver | Indicative Noise Amenity Area | Time of Day[1] | Recommended $L_{Aeq(Period)}$[2] Noise Level (dBA) | |
|---|---|---|---|---|
| | | | Acceptable | Recommended Maximum |
| Residence | Rural | Day | 50 | 55 |
| | | Evening | 45 | 50 |
| | | Night | 40 | 45 |
| | Suburban | Day | 55 | 60 |
| | | Evening | 45 | 50 |
| | | Night | 40 | 45 |
| Residence | Urban | Day | 60 | 65 |
| | | Evening | 50 | 55 |
| | | Night | 45 | 50 |
| | Urban/Industrial Interface (for existing situations only) | Day | 65 | 70 |
| | | Evening | 55 | 60 |
| | | Night | 50 | 55 |
| School classrooms<br>- internal | All | Noisiest 1 hour period when in use | 35 | 40 |
| Hospital wards<br>- internal<br>- external | All | <br>Noisiest 1 hour period | <br>35<br>50 | <br>40<br>55 |
| Place of worship<br>- internal | All | When in use | 40 | 45 |
| Area specifically reserved for passive recreation (eg National Park) | All | When in use | 50 | 55 |
| Active recreation area (eg school playground, golf course) | All | When in use | 55 | 60 |
| Commercial premises | All | When in use | 65 | 70 |
| Industrial premises | All | When in use | 70 | 75 |

Note 1: Daytime 7.00 am - 6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 7.00 am, On Sundays and Public Holidays, Daytime 8.00 am -6.00 pm; Evening 6.00 pm - 10.00 pm; Night-time 10.00 pm - 8.00 am.

Note 2: The $L_{Aeq}$ index corresponds to the level of noise equivalent to the energy average of noise levels occurring over a measurement period.

If noise from the existing industry approaches the ANL, then noise from new industries needs to be designed so that the cumulative level does not significantly exceed the criterion.

Applicable amenity criteria are determined based on the ANL and the existing levels of industry noise in accordance with **Table 3**.

**Table 3 Modification to Acceptable Noise level (ANL)***

| **Total Existing $L_{Aeq}$ noise level from Industrial Noise Sources** | **Maximum $L_{Aeq}$ Noise Level for Noise from New Sources Alone, dBA** |
|---|---|
| ≥ Acceptable noise level plus 2 dBA | If existing noise level is *likely to decrease* in future acceptable noise level minus 10 dBA<br>If existing noise level is *unlikely to decrease* in future existing noise level minus 10 dBA |
| Acceptable noise level plus 1 dBA | Acceptable noise level minus 8 dBA |
| Acceptable noise level | Acceptable noise level minus 8 dBA |
| Acceptable noise level minus 1 dBA | Acceptable noise level minus 6 dBA |
| Acceptable noise level minus 2 dBA | Acceptable noise level minus 4 dBA |
| Acceptable noise level minus 3 dBA | Acceptable noise level minus 3 dBA |
| Acceptable noise level minus 4 dBA | Acceptable noise level minus 2 dBA |
| Acceptable noise level minus 5 dBA | Acceptable noise level minus 2 dBA |
| Acceptable noise level minus 6 dBA | Acceptable noise level minus 1 dBA |
| < Acceptable noise level minus 6 dBA | Acceptable noise level |

* ANL = recommended acceptable $L_{Aeq}$ noise level for the specific receiver, area and time of day from **Table 2.**

### 3.2.3 INP Project Specific Criteria

The INP Project Specific Noise levels are the more stringent of either the amenity or intrusive criteria. The INP states that these criteria have been selected to protect at least 90% of the population living in the vicinity of industrial noise sources from the adverse effects of noise for at least 90% of the time. Provided the criteria in the INP are achieved, it is unlikely that most people would consider the resultant noise levels excessive.

In those cases where the INP project specific assessment criteria are not achieved, it does not automatically follow that all people exposed to the noise would find the noise unacceptable. In subjective terms, exceedances of the INP project specific assessment criteria can be generally described as follows:

- Negligible noise level increase <1 dB(A) (Not noticeable by all people)
- Marginal noise level increase 1 dB(A) to 2 dB(A) (Not noticeable by most people)
- Moderate noise level increase 3 dB(A) to 5 dB(A) (Not noticeable by some people but may be noticeable by others)
- Appreciable noise level increase >5 dB(A) (Noticeable by most people)

In view of the foregoing, **Table 4** presents the methodology for assessing noise levels which may exceed the INP project specific noise assessment criteria.

**Table 4 Noise Impact Assessment Methodology**

| **Assessment Criteria** | **Project Specific Criteria** | **Noise Management Zone** | **Noise Affectation Zone** |
|---|---|---|---|
| Intrusive | Rating background level<br>plus 5 dBA | ≤ 5 dBA above project specific criteria | > 5 dBA above project specific criteria |
| Amenity | INP based on existing industrial level | ≤ 5 dBA above project specific criteria | > 5 dBA above project specific criteria |

For the purposes of assessing the potential noise impacts the project specific, management and affectation criteria are further defined as follows:

**Project Specific Criteria**

Most people in the broader community would generally consider exposure to noise levels corresponding to this zone acceptable.

**Noise Management Zone**

Depending on the degree of exceedance of the project specific criteria (1 dBA to 5 dBA) noise impacts could range from negligible to moderate. It is recommended that management procedures be implemented including:

- Prompt response to any community issues of concern.
- Noise monitoring on site and within the community.
- Refinement of on-site noise mitigation measures and plant operating procedures where practical.
- Consideration of acoustical mitigation at receivers.
- Consideration of negotiated agreements with property holders.

**Noise Affectation Zone**

Exposure to noise levels exceeding the project-specific criteria by more than 5 dB(A) may be considered unacceptable by some property holders and the INP recommends that the proponent explore the following.

- Discussions with relevant property holders to assess concerns and provide solutions.
- Implementation of acoustical mitigation at receivers.
- Negotiated agreements with property holders, where required.

## 3.3 Consideration of Prevailing Weather Conditions

### 3.3.1 Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the noise source. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the area under consideration. Where the source to receiver wind component at speeds of up to 3 m/s occur for 30% or more of the time in any seasonal period (during the day, evening or night), then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

The INP Section 5.3 Wind Effects states:

> *"Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source to receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30 percent of the time or more in any assessment period in any season."*

Ab analysis of wind speed and direction has not been undertaken as part of this study. However, noise from the solar farm has been assessed using both calm and enhanced 2 m/s winds (from the source to **all** receptors). Full details regarding the parameters used for noise modelling are provided in **Section 3.3.3**.

### 3.3.2 Temperature Inversion

The NSW INP states that temperature inversions need only be considered for the night-time noise assessment period (10.00 pm to 7.00 am).

The INP states:

*"Temperature inversions occur during E, F and G stability categories. These three categories are considered to represent weak, moderate and strong inversions respectively. For noise-assessment purposes, only moderate and strong inversions are considered significant enough to require assessment."*

*"In dispersion modelling, stability class is used to categorise the rate at which a plume will disperse. In the Pasquill-Gifford stability class assignment scheme there are six stability classes, A through to F. Class A relates to unstable conditions, such as might be found on a sunny day with light winds. Class F relates to stable conditions, such as those that occur when the sky is clear, the winds are light and an inversion is present. The intermediate classes B, C, D and E relate to intermediate dispersion conditions. A seventh class, G, has also been defined to accommodate extremely stable conditions such as might be found in arid rural areas."*

An analysis of the occurrence of each stability class has not been conducted. However, to provide for a conservative 'worst case' assessment, noise modelling of day and evening operations at the solar farm allows for a temperature inversion (i.e. Pasquil Stability Category F – see **Table 5**) or alternatively strong winds from the source to the receptor.

With regard to construction noise impacts, as all construction works will be undertaken during the day period (when the likelihood of temperature inversions is significantly reduced), construction noise from the facility has only been modelled under Pasquil Stability Category C (i.e. intermediate dispersion conditions).

### 3.3.3 Noise Modelling Parameters for Meteorological Conditions

The resultant weather conditions used to predict the level of noise for the different modelling scenarios are shown below:

Construction and Operational Noise – Neutral Conditions (Meteorological Category 4):

- 2 m/s wind from source to receiver, Pasquil Stability Class C

Construction Noise – Enhanced Propagation Conditions (Meteorological Category 5):

- 2 m/s wind from source to receiver, Pasquil Stability Class C

Operational Noise – Enhanced Propagation Conditions (Meteorological Category 6):

- 2 m/s wind from source to receiver, Pasquil Stability Class F or;
- Greater than 3 m/s winds from source to receiver, Pasquil Stability Class C, D, or E.

It is noted that the meteorological categories used in the modelling allow for a range of different combinations of wind speeds and Pasquil stability classes as shown in **Table 5**. For example, as the worst case operational noise impacts have been modelled using Meteorological Category 6, this condition also allows for strong winds (greater than 3 m/s) under Pasquil Stability Class C, D or E.

**Table 5 Meteorological Parameters for Noise Modelling**

| Noise Modelling Scenario | Propagation Condition | Meteorological Category | Wind Velocity (m/s) | Pasquil Stability Category |
|---|---|---|---|---|
| Construction & Operational | Neutral Weather | 4 | 0.5 < V < 3.0 | A, B (day) |
| | | | -0.5 < V < 0.5 | C, D, E (day) |
| | | | -3 < V < -0.5 | F, G (evening & night) |
| Construction | Enhanced "worst case" weather | 5 | V > +3.0 | A, B (day) |
| | | | 0.5 < V < 3.0 | C, D, E (day) |
| | | | -0.5 < V < 0.5 | F (evening & night) |
| Operational | Enhanced "worst case" weather | 6 | V > +3.0 | C, D, E (day) |
| | | | 0.5 < V < 3.0 | F, G (evening & night) |

## 3.4 Additional EPA Noise Assessment Information

The EPA's recommended noise assessment criteria aim to limit potential intrusive noise emissions and preserve noise amenity. In cases where the limiting noise assessment criterion cannot be achieved, then practicable and economically feasible noise control measures should be applied. This usually requires demonstration that Best Achievable Technology and Best Environmental Management Practices have been implemented in order to mitigate adverse acoustical impacts.

In the event that the lowest achievable noise emission levels remain above the noise assessment criteria, the potential noise impact needs to be balanced and assessed against any economic and social benefits the project may bring to the community. It then follows that where the consenting authority may consider that the development does offer community benefits, then these may be grounds for permitting achievable noise emission levels as statutory compliance levels.

# 4 EXISTING NOISE ENVIRONMENT

## 4.1 Background Noise Levels

### 4.1.1 2007 (i.e. Pre Wind Farm construction) Background Noise Monitoring

Unattended noise monitoring was previously undertaken by Marshall Day Acoustics (MDA) as part of the pre-construction operational noise impact assessment for the wind farm. The results presented in the MDA Report entitled "*Gullen Range Wind Farm Noise Impact Assessment":–* Report No. *2007265SY 001 R02* dated 4th June 2008 (hereafter, MDA Report 2007265SY-R2) have been used to help determine applicable noise limits for this project.

MDA conducted background noise monitoring between June and November of 2007 at 16 representative locations. Two of these monitoring locations are located within the vicinity of the proposed solar farm and deemed representative of those dwellings located to the north and south of the facility.

The monitoring locations are shown in **Figure 3** along with other identified sensitive receptors within 1.5 km of the solar farm.

It is noted that the background noise monitoring conducted in 2007 was undertaken *before* the construction of the wind farm. As such, the background noise levels do not include any contribution from the wind farm.

**Figure 3 Ambient Noise Monitoring Locations**

The five dwellings to the north / northeast of the solar farm were not identified as relevant in the earlier assessment due to their relatively large distance from the wind farm. In order to assess noise to these dwellings, background noise levels based on receptor B11 have been adopted.

The dwelling at PW34 which is located within the site of the solar farm will be retained and owned by the proponent. Consequently, noise from the facility is not assessable to this dwelling and has not been included as part of the assessment.

The background noise monitoring results from the 2007 survey were analysed to determine the Rating Background Level (RBL) for the respective day, evening and night periods.

**Table 6** details receptors considered in this assessment along with the representative background monitoring locations (used as part of the earlier assessment of the wind farm) and resultant RBL's. The UTM coordinates for each of the identified sensitive receptors is also shown, along with the approximate distance to the site boundary of the solar farm.

**Table 6 Ambient Background noise levels for Receptor Catchment Areas (Pre-construction)**

| Receptor Locations | UTM (Zone 55) Coordinates | | Measured RBL at Representative Receptor, dBA | | | Approximate Distance to Site Boundary (m) |
|---|---|---|---|---|---|---|
| | Easting (m) | Northing (m) | Day (0700h – 1800h) | Evening (1800h – 2200h) | Night (2200h – 0700h) | |
| **Ambient Background Noise Monitoring Location B11 (Representative of Receptors to North of Site)** | | | | | | |
| B11 | 725247 | 6169678 | 34 | 36 | 34 | 1600 |
| B35 | 726008 | 6169394 | 34 | 36 | 34 | 1470 |
| B38 | 728292 | 6168955 | 34 | 36 | 34 | 1540 |
| B38A | 728115 | 6168732 | 34 | 36 | 34 | 1280 |
| B45 | 726941 | 6169421 | 34 | 36 | 34 | 1650 |
| B47 | 727704 | 6169126 | 34 | 36 | 34 | 1550 |
| B48 | 727611 | 6169056 | 34 | 36 | 34 | 1480 |
| B49 | 728055 | 6169108 | 34 | 36 | 34 | 1620 |
| **Ambient Background Noise Monitoring Location PW7 (Representative of Receptors around Site / Southern Region of Figure 3)** | | | | | | |
| PW5 | 725649 | 6167872 | 33 | 33 | 29 | 135 |
| PW7 | 725225 | 6166206 | 33 | 33 | 29 | 1030 |
| PW29 | 724534 | 6166969 | 33 | 33 | 29 | 1260 |
| PW34* | 726546 | 6167423 | 33 | 33 | 29 | - |
| PW35 | 728980 | 6167173 | 33 | 33 | 29 | 1180 |
| PW36 | 725240 | 6167640 | 33 | 33 | 29 | 490 |

Note * Project involved receptor

### 4.1.2 2014 Post Wind Farm Construction Background Noise Monitoring

As part of the consent conditions for the wind farm it is understood that GoldWind was required to commit to compliance noise measurements in the surrounding residential areas following construction of the windfarm.

MDA conducted unattended noise monitoring at the same two locations (B11 and PW7) between December 2014 and April 2015 while the windfarm was operational.

The noise monitoring results from the more recent 2014 / 2015 (i.e. post construction) noise monitoring campaign were used to determine day, evening and night RBL's which are presented in **Table 7** compared with the earlier (pre-construction) 2007 results.

**Table 7 Comparison of Measured Background Noise Levels**

| Assessment Period for Monitoring Location | Measured RBL at Monitoring Location, dBA (for MDA Monitoring Campaign) | |
|---|---|---|
| **Receptor B11** | **2007** | **2014/2015** |
| **Day (0700h – 1800h)** | 34 | 32 |
| **Evening (1800h – 2200h)** | 36 | 38 |
| **Night (2200h – 0700h)** | 34 | 28 |
| **Receptor PW7** | **2007** | **2014/2015** |
| **Day (0700h – 1800h)** | 33 | 33 |
| **Evening (1800h – 2200h)** | 33 | 36 |
| **Night (2200h – 0700h)** | 29 | 31 |

Whilst we would generally expect noise levels to increase after the introduction of a new noise source to an area; it is noted that this is not necessarily the case, especially for a windfarm. This is primarily due to the significant distance from the receptor locations (especially for B11) to any wind turbines, combined with the unique nature of noise from such a facility (i.e. noise levels are dependent on wind speed which also effects background noise levels).

Furthermore other factors such as seasonal weather, changes in local road traffic conditions, wildlife, different monitoring requirements (possible use of alternative monitoring location) etc. can all have an effect on the measured noise levels.

The noise monitoring results presented in **Table 7** show that the measured RBL's for the day and evening periods did not vary by more than 3 dBA. With the exception of the daytime monitoring period for B11, the measured RBL's for the day and evening periods during the 2014 / 2015 monitoring period were louder.

For the evening periods the measured RBL's during the 2014 / 2015 campaign were 2 to 3 dBA louder than the 2007 (pre-construction) results.

For the night period the measured noise levels for the post-construction 2014 / 2015 monitoring period were actually lower by 6 dBA at receptor B11 and 2 dBA at PW7. It is possible that this may be due to local wildlife (i.e. crickets or frogs) during the night period for the 2007 winter monitoring period.

The lowest measured background noise levels are presented in **Table 8**.

**Table 8 Ambient Background noise levels for Receptor Catchment Areas**

| Receptor Locations | UTM (Zone 55) Coordinates | | Measured RBL at Representative Receptor, dBA | | | Approximate Distance to Site Boundary (m) |
|---|---|---|---|---|---|---|
| | Easting (m) | Northing (m) | Day (0700h – 1800h) | Evening (1800h – 2200h) | Night (2200h – 0700h) | |
| **Ambient Background Noise Monitoring Location B11 (Representative of Receptors to North of Site)** | | | | | | |
| B11 | 725247 | 6169678 | 32 | 36 | 28 | 1600 |
| B35 | 726008 | 6169394 | 32 | 36 | 28 | 1470 |
| B38 | 728292 | 6168955 | 32 | 36 | 28 | 1540 |
| B38A | 728115 | 6168732 | 32 | 36 | 28 | 1280 |
| B45 | 726941 | 6169421 | 32 | 36 | 28 | 1650 |
| B47 | 727704 | 6169126 | 32 | 36 | 28 | 1550 |
| B48 | 727611 | 6169056 | 32 | 36 | 28 | 1480 |
| B49 | 728055 | 6169108 | 32 | 36 | 28 | 1620 |
| **Ambient Background Noise Monitoring Location PW7 (Representative of Receptors around Site / Southern Region of Figure 3)** | | | | | | |
| PW5 | 725649 | 6167872 | 33 | 33 | 29 | 135 |
| PW7 | 725225 | 6166206 | 33 | 33 | 29 | 1030 |
| PW29 | 724534 | 6166969 | 33 | 33 | 29 | 1260 |
| PW34* | 726546 | 6167423 | 33 | 33 | 29 | - |
| PW35 | 728980 | 6167173 | 33 | 33 | 29 | 1180 |
| PW36 | 725240 | 6167640 | 33 | 33 | 29 | 490 |

Note * Project involved receptor

## 4.2 Existing Industry / Consideration of Cumulative Noise Impacts

There are no significant sources of industrial noise in the rural area surrounding the proposed solar farm. Whilst there is an existing wind farm, it is subject to very different criteria as the noise source (and background noise environment) can vary significantly with wind speed and direction. Furthermore, noise from the wind farm has already been assessed in accordance with applicable criteria (i.e. the 2003 South Australia Environment Protection Authority (SA EPA) Guidelines) in the MDA Report.

Consequently, noise from the wind farm should not be assessed using NSW INP. However, for the purpose of considering cumulative noise emissions from the wind farm, an indicative assessment has been provided.

In order to do this, the highest levels of wind farm noise at each receptor were determined from the MDA Report. It is noted that the corresponding wind speeds typically range from 9 m/s to 11 m/s (at hub height i.e. 80 m to 100 m above ground).

The maximum identified noise levels from the wind farm (at the receptors to the north) were found to range from 27 dBA to 36 dBA, Leq. For the dwellings in the immediate surrounds and to the south of the solar farm the maximum levels of wind farm noise vary between 37 dBA and 41 dBA, $L_{eq}$.

The highest level of noise from the wind farm to a receptor within each catchment area has been used for determining applicable amenity noise criteria.

# 5 PROJECT SPECIFIC NOISE EMISSION CRITERIA

## 5.1 Construction Noise

The RBL's have been used to calculate construction noise goals at receptor locations. Results are presented in **Table 9**.

**Table 9 Construction Noise Management Levels – Noise Affected**

| Location | Period | RBL, dBA | Construction Nose Goal, dBA, Leq (15 min) | |
|---|---|---|---|---|
| | | | Noise Affected | Highly Noise Affected |
| B11 (North Receptors) | Day[1] | 32 | 42 | 75 |
| | Evening [2] | 36 | 41 | 75 |
| | Night [3] | 28 | 33 | 75 |
| PW7 (Site / South Receptors) | Day[1] | 33 | 43 | 75 |
| | Evening [2] | 33 | 38 | 75 |
| | Night [3] | 29 | 34 | 75 |

NOTE 1: Day period noise goal = RBL + 10 dBA
NOTE 2: Evening period noise goal = RBL + 5 dBA
NOTE 3: Night period noise goal = RBL + 5 dBA

## 5.2 Operational Noise

The operational noise emission design criteria for the proposed development have been established with reference to the INP using the procedure outlined in **Section 3.2** of this report.

The resulting operational project specific noise criteria for the proposed development are shown in **bold** in **Table 10**.

**Table 10 Project Specific Noise Criteria**

| Receiver | Time of Day | Noise Level, dBA | | | | |
|---|---|---|---|---|---|---|
| | | ANL[1] (period) | Measured RBL | Predicted[2] LAeq | INP Criteria | |
| | | | | | Intrusive LAeq(15minute) | Amenity LAeq(Period)[3, 4] |
| B11 (North Receptors) | Day | 50 | 32 | 36 | **37** | 50[3] |
| | Evening | 45 | 36 | 36 | **41** | 45[3] |
| | Night | 40 | 28 | 36 | **33** | 38[3] |
| PW7 (Site / South Receptors) | Day | 50 | 33 | 41 | **38** | 50[3] |
| | Evening | 45 | 33 | 41 | **38** | 43[3] |
| | Night | 40 | 29 | 41 | 34 | **32[3]** |

Note 1: ANL Acceptable Noise Level for a rural area
Note 2: The level of existing industrial noise to the surrounding residential areas has been conservatively based on the highest predicted noise from the wind farm within each catchment area (see **Section 4.2**)
Note 3: Assuming existing noise levels are unlikely to decrease
Note 4: Adjustments applied in accordance with **Table 3** to determine appropriate modification factors.

In accordance with INP methodology, operational noise from the solar farm has been assessed to the more onerous of the intrusive and amenity criteria (i.e. the 'Project Specific Noise Criteria' – in this case the intrusiveness criteria).

In addition to the above, cumulative noise emissions from both the wind and solar farm have also been assessed using the amenity criteria which was conservatively determined based on the highest possible noise levels from the existing wind farm.

### 5.3 Sleep Disturbance

As the construction works will only be undertaken during the day period there will be no sleep disturbance or night time noise impacts as a result of these works.

Similarly, during normal operation of the solar farm there will be minimal noise impacts during the night period as the associated infrastructure will be under minimum / no load. Consequently, noise from the solar farm has not been assessed to sleep disturbance and night time noise criteria.

# 6 CONSTRUCTION NOISE ASSESSMENT

## 6.1 Construction Stages

To assess the potential noise and vibration impacts during construction, a number of scenarios comprising typical plant and equipment have been developed based on the indicative staging information as outline in the SEE document and repeated in **Section 2.4**. These are summarised in **Table 11**.

It is understood that all construction works are proposed to be undertaken during standard daytime periods (7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays).

**Table 11 Construction Scenarios**

| Stage | Scenario | Equipment | No. of plant in 15 min period | Maximum $L_{Aeq}$ Sound Power Level (dBA) |
|---|---|---|---|---|
| 1 | Site Preparation, Clearing & Demolition | Excavator (clearing site) | 2 | 105 |
| | | Bulldozer 28T | 1 | 107 |
| | | Chainsaw | 2 | 117(1,2) |
| | | Tree mulcher | 1 | 115 |
| | | Light vehicles | 2 | 94 |
| | | Dump truck (for disposal of material) | 1 | 106 |
| 2 | Establish Site Compound, Access Roads & Delivery of Materials | Hand Tools | 2 | 94 |
| | | Excavator (earthworks) | 2 | 107 |
| | | Light vehicles | 3 | 94 |
| | | Delivery trucks / semi-trailers | 3 | 100(2) |
| | | Bulldozer (28T Ground exc. works) | 1 | 107 |
| | | DPU / Plate Compactor | 2 | 103 |
| | | Grader | 1 | 107 |
| | | Roller (18T Rolling fill) | 1 | 102 |
| | | Asphalt paver & Tipper Lorry | 1 | 108 |
| | | Bobcat | 1 | 104 |
| | | Bored piling rig | 1 | 114 |
| | | Telehandler | 2 | 105 |
| | | 20-50T Mobile Crane | 1 | 106 |
| 3 | Installation of Foundations | Driven piling rig | 1 | 114(1,2) |
| | | Bobcat | 1 | 104 |
| | | Crane | 2 | 106 |
| | | Excavator | 2 | 107 |
| | | Concrete vibrating needle | 2 | 103 |
| | | Concrete agitator truck (discharging) | 1 | 103 |
| | | Concrete agitator truck (low to mid revs) | 1 | 107 |

| Stage | Scenario | Equipment | No. of plant in 15 min period | Maximum LAeq Sound Power Level (dBA) |
|---|---|---|---|---|
| 4 | Installation of Underground Cabling | Vermeer Trencher | 2 | 105 |
| | | Cable laying trailer & tractor | 2 | 103 |
| | | Loader | 2 | 110 |
| 5 | Assembly of Panel Frames, Mounts & Transformer Units | Telehandler | 2 | 105 |
| | | Hiab truck | 2 | 104 |
| | | Generator | 2 | 99 |
| | | Compressor | 1 | 93 |
| | | Hand tools | 2 | 94 |
| | | Ratchet gun | 4 | 106(1) |
| | | 20-50T Mobile Crane | 1 | 106 |
| 6 | Site Rehabilitation / Removal of Temporary Construction Facilities | Light vehicles | 2 | 98 |
| | | Excavator (clearing site) | 2 | 106 |
| | | Bulldozer 28T | 1 | 107 |
| | | Loader | 1 | 110 |
| | | Dump truck (for disposal of material) | 2 | 106 |
| | | Semi-trailer | 1 | 104 |

Note 1: Denotes “annoying” item of equipment as defined in the ICNG (i.e. contains characteristics such as impulsiveness, tonality etc.), and as such includes a +5 dB penalty adjustment to predictions.

Note 2: Overall SWL assumes a maximum duration of 7.5 minutes operation in any 15 minute period.

## 6.2 Construction Noise Modelling Parameters

To allow for the complex effects due to shielding and reflection provided by the various buildings, a three dimensional (3D) computer noise model was prepared using the SoundPLAN V7.2 computer noise modelling package. To predict the level of noise at the allocated receiver locations the CONCAWE algorithm was used with both calm / neutral (Category 4) and worst case (Category 5) atmospheric conditions (see **Section 3.3.3**).

It is noted that the surrounding land is predominantly used for farming type usage (i.e. covered in fields, forests or grass). With regard to land encompassing the site, it is understood that grazing would be used as a ground cover management strategy beneath and around the solar array. Consequently, whilst the surrounding ground cover would be more accurately represented as soft absorptive ground (i.e. a ground absorption factor of G= 1), the calculations conservatively include a mixture of soft and hard ground (G = 0.5) for all ground cover.

The calculations include the source noise levels of the anticipated equipment, the location of the nearest sensitive receivers, the number of plant items likely to be operating at any given time and the distance between the equipment and the receivers. The predictions are representative of a worst-case scenario with all equipment listed in **Table 11** operating simultaneously.

In practice, noise levels will depend on the number of plant items and equipment operating at any one time and their precise location relative to the receiver of interest. Noise levels will vary due to the movement of plant and equipment about the worksites and the concurrent operation of plant. In some cases, reductions in noise levels will occur when plant are shielded from sensitive receivers behind hoarding, buildings or other items of equipment.

## 6.3 Construction Noise Modelling Results

The results presented in **Table 12** have been compared with the relevant design goals. Noise contour plots for the scenarios are also presented in **Appendix C** and **Appendix D** for neutral / calm and worst case propagation conditions respectively.

**Table 12 Construction Noise Predictions**

| Stage | Scenario | Receiver | | Noise Level – Leq(15minute) (dBA) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Predicted Noise at Dwelling | | NML, Noise Affected | NML Excess (Worst Case) |
| | | | | Calm | Worst Case | | |
| 1 | Site Preparation, Clearing & Demolition | North of Site | B11 | 31 | 36 | 42 | 0 |
| | | | B35 | 34 | 40 | 42 | 0 |
| | | | B38 | 30 | 36 | 42 | 0 |
| | | | B38A | 33 | 38 | 42 | 0 |
| | | | B45 | 34 | 39 | 42 | 0 |
| | | | B47 | 34 | 39 | 42 | 0 |
| | | | B48 | 34 | 40 | 42 | 0 |
| | | | B49 | 31 | 36 | 42 | 0 |
| | | Site / South Receptors | PW5 | 47 | 52 | 43 | 9 |
| | | | PW7 | 21 | 26 | 43 | 0 |
| | | | PW29 | 32 | 38 | 43 | 0 |
| | | | PW35 | 33 | 39 | 43 | 0 |
| | | | PW36 | 38 | 43 | 43 | 0 |
| 2 | Establish Site Compound, Access Roads & Delivery of Materials | North of Site | B11 | 27 | 33 | 42 | 0 |
| | | | B35 | 31 | 37 | 42 | 0 |
| | | | B38 | 30 | 35 | 42 | 0 |
| | | | B38A | 32 | 37 | 42 | 0 |
| | | | B45 | 31 | 37 | 42 | 0 |
| | | | B47 | 32 | 37 | 42 | 0 |
| | | | B48 | 33 | 38 | 42 | 0 |
| | | | B49 | 30 | 36 | 42 | 0 |
| | | Site / South Receptors | PW5 | 42 | 46 | 43 | 3 |
| | | | PW7 | 17 | 22 | 43 | 0 |
| | | | PW29 | 30 | 36 | 43 | 0 |
| | | | PW35 | 32 | 37 | 43 | 0 |
| | | | PW36 | 37 | 42 | 43 | 0 |

| Stage | Scenario | Receiver | | Noise Level – Leq(15minute) (dBA) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Predicted Noise at Dwelling | | NML, Noise Affected | NML Excess (Worst Case) |
| | | | | Calm | Worst Case | | |
| 3 | Installation of Foundations | North of Site | B11 | 29 | 35 | 42 | 0 |
| | | | B35 | 33 | 39 | 42 | 0 |
| | | | B38 | 30 | 36 | 42 | 0 |
| | | | B38A | 32 | 38 | 42 | 0 |
| | | | B45 | 33 | 39 | 42 | 0 |
| | | | B47 | 33 | 39 | 42 | 0 |
| | | | B48 | 34 | 39 | 42 | 0 |
| | | | B49 | 31 | 37 | 42 | 0 |
| | | Site / South Receptors | PW5 | 42 | 47 | 43 | 4 |
| | | | PW7 | 20 | 26 | 43 | 0 |
| | | | PW29 | 31 | 37 | 43 | 0 |
| | | | PW35 | 32 | 38 | 43 | 0 |
| | | | PW36 | 37 | 43 | 43 | 0 |
| 4 | Installation of Underground Cabling | North of Site | B11 | 26 | 32 | 42 | 0 |
| | | | B35 | 29 | 35 | 42 | 0 |
| | | | B38 | 29 | 35 | 42 | 0 |
| | | | B38A | 31 | 36 | 42 | 0 |
| | | | B45 | 30 | 36 | 42 | 0 |
| | | | B47 | 31 | 36 | 42 | 0 |
| | | | B48 | 31 | 37 | 42 | 0 |
| | | | B49 | 29 | 35 | 42 | 0 |
| | | Site / South Receptors | PW5 | 37 | 42 | 43 | 0 |
| | | | PW7 | 16 | 21 | 43 | 0 |
| | | | PW29 | 26 | 32 | 43 | 0 |
| | | | PW35 | 29 | 34 | 43 | 0 |
| | | | PW36 | 33 | 39 | 43 | 0 |
| 5 | Assembly of Panel Frame, Mounts & Transformer Units | North of Site | B11 | 21 | 26 | 42 | 0 |
| | | | B35 | 25 | 30 | 42 | 0 |
| | | | B38 | 21 | 26 | 42 | 0 |
| | | | B38A | 25 | 30 | 42 | 0 |
| | | | B45 | 26 | 31 | 42 | 0 |
| | | | B47 | 27 | 32 | 42 | 0 |
| | | | B48 | 28 | 33 | 42 | 0 |
| | | | B49 | 21 | 27 | 42 | 0 |
| | | Site / South Receptors | PW5 | 34 | 39 | 43 | 0 |
| | | | PW7 | 12 | 17 | 43 | 0 |
| | | | PW29 | 23 | 28 | 43 | 0 |
| | | | PW35 | 30 | 35 | 43 | 0 |
| | | | PW36 | 30 | 34 | 43 | 0 |

| Stage | Scenario | Receiver | | Noise Level – Leq(15minute) (dBA) | | | |
|---|---|---|---|---|---|---|---|
| | | | | Predicted Noise at Dwelling | | NML, Noise Affected | NML Excess (Worst Case) |
| | | | | Calm | Worst Case | | |
| 6 | Site Rehabilitation / Removal of Temporary Construction Facilities | North of Site | B11 | 27 | 33 | 42 | 0 |
| | | | B35 | 31 | 36 | 42 | 0 |
| | | | B38 | 28 | 33 | 42 | 0 |
| | | | B38A | 30 | 36 | 42 | 0 |
| | | | B45 | 30 | 36 | 42 | 0 |
| | | | B47 | 31 | 37 | 42 | 0 |
| | | | B48 | 32 | 38 | 42 | 0 |
| | | | B49 | 28 | 34 | 42 | 0 |
| | | Site / South Receptors | PW5 | 40 | 44 | 43 | 1 |
| | | | PW7 | 18 | 23 | 43 | 0 |
| | | | PW29 | 28 | 34 | 43 | 0 |
| | | | PW35 | 30 | 35 | 43 | 0 |
| | | | PW36 | 35 | 41 | 43 | 0 |

Note: The results have been formatted to provide a visual comparison of the predicted noise level at the receptor:

Green Below Noise Affected NML (i.e. RBL + 10 dBA for day works).

Orange Predicted noise level above Noise Affected NML but less than Highly Noise Affected

Red Predicted noise level above Highly Noise Affected NML criteria (i.e. 75 dBA).

## 6.4 Discussion

The noise modelling results indicate that construction noise during all stages of works will be well below the highly noise affected NML criterion of 75 dBA.

Noise associated with the required construction works are predicted to comply with the ICNG criteria for most scenarios, the only exceptions being:

- Stage 1 – Site Preparation, Clearing & Demolition
- Stage 2 – Establish Site Compound, Access Roads & Delivery of Materials.
- Stage 3 – Installation of Foundations, and;
- Stage 6 – Site Rehabilitation / Removal of Temporary Construction Facilities

In all cases (with the exception of Stage 3), the only exceedance was predicted at receptor PW5 which is located approximately 130 m west of the site.

A brief discussion of the results for these scenarios is provided below.

**Stage 1 – Site Preparation, Clearing & Demolition**

From **Table 12** it is evident that during this stage the predicted noise levels at PW5 ranged between 47 dBA and 52 dBA, Leq which equates to an exceedance of the lower 'Noise Affected NML' of 4 dBA to 9 dBA.

The dominant noise source at this receptor (during this stage) is likely to be the chainsaws and mulcher required for the site clearing works.

The predicted noise levels at all other receptors complied with applicable ICNG criteria.

**Stage 2 – Establish Site Compound, Access Roads & Delivery of Materials**

During the Stage 2 works noise levels were predicted to comply at all receptors under calm / neutral propagation conditions. However, under enhanced conditions (i.e. a slight easterly wind) the predicted construction noise at PW5 exceeded the NML criteria by 3 dBA.

**Stage 3 – Installation of Foundations**

Construction noise during Stage 3 was found to comply with applicable ICNG criteria at all sensitive receptors under neutral propagation conditions. Under enhanced propagation conditions the predicted noise levels comply at all receptors with the exception of PW5 where a 4 dBA excess was predicted.

It is noted that this minor excess is predominantly due to the operation of a driven piling required to operate more than 900 m from the closest residential property. Furthermore, information provided by the piling contractor indicates that it will typically take 1 minute to drive each pile with a 2-3 minute respite period (between piles) while the next pile is prepared.

Given the conservative nature of the assessment, predicted exceedance (i.e. only under enhanced propagation conditions), and daytime construction works there will be minimal noise impacts during this stage.

**Stage 6 – Site Rehabilitation / Removal of Temporary Construction Facilities**

The predicted noise levels at the surrounding receptors during the final stage of construction works ranged from 26 dBA to 41 dBA, $L_{eq}$. Once again, the highest noise level was predicted at PW5, with a 4 dBA increase under enhanced noise propagation conditions which equates to a marginal 1 dBA excess of the daytime NML.

## 6.5 Construction Noise Summary

The results indicate that during some of the stages there will be a few minor noise impacts at the closest dwelling PW5.

Under worst case propagation conditions, the highest noise levels were predicted during the early Stage 1 *'Site Preparation, Clearing & Demolition'* works. During this stage noise levels up to 52 dBA were predicted at PW5 which equates to an excess of the daytime NML of 9 dBA. Whilst this is sufficient for the operation of the chain saw to be clearly audible (when operating in the closer areas), the noise levels are likely to be tolerated given the daytime works period.

For the other stages where the NML's were exceeded (i.e. Stages 2, 3 and 6), the excess was only at PW5 under enhanced propagation conditions, with construction noise exceeding the NML criterion by up to 4 dBA.

It should be noted that the noise modelling approach adopted is very conservative as most plant has assumed to be operating 100% of the time with a mixture of hard and soft ground across the site and surrounding area. Noise modelling results indicate that a reduction in noise levels in the order of 3 dBA to 6 dBA (depending on receptor location) could possibly be attributed to ground absorption alone.

In accordance with the ICNG it is recommended that the proponent inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as appropriate site contact details.

## 6.6 Construction Noise Control Measures

In order to minimise potential noise impacts on nearby sensitive receivers, it is understood that all construction works are proposed to be undertaken during the EPA's standard daytime construction periods (i.e. 7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays).

The predicted noise levels during the various construction stages were well below the highly noise affected criterion provided in the ICNG. Whilst the lower NML criteria at receptor PW5 may be exceeded by a small margin for short periods of time (primarily due to the operation of nearby / localised plant and slight easterly winds), site specific mitigation strategies are not necessary.

Nonetheless, it is recommended that AS 2436-2010 "*Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*" is used assist in mitigating general construction noise emissions. Examples of strategies that could be implemented on the project are provided in **Appendix F**.

It should be noted that following the previous submission provided in SLR Report 640.10935-R1R3 (dated the 15 January 2016) the layout for the solar farm has been adjusted such that no solar panels or inverters are located along the western portion of the property. For the new layout the distance from the closest dwelling to any potential piling works has increased from approximately 320 m to 900 m. Consequently, the predicted noise levels associated with the required piling works for the finalised layout comply with applicable ICNG criteria under the predominantly neutral / calm propagation conditions. Whilst a relatively minor 4 dB excess is predicted at receptor PW5 under enhanced propagation conditions (i.e. a slight easterly wind or early morning temperature inversion) while the piling rig is working on the west cluster of solar panels, it is noted that the excess is relatively minor and unlikely to occur for extended periods of time.

Based on the updated noise modelling results for the revised solar farm layout, the proposed restrictions to available working hours for piling works are not required.

# 7 OPERATIONAL NOISE ASSESSMENT

## 7.1 Methodology

In order to determine the acoustical impact of the proposed solar farm, a computer model incorporating all significant noise sources; the closest potentially affected residential properties, and the intervening terrain has been prepared.

The computer model was prepared using the SoundPLAN V7.2 Industrial Module which allows the use of various internationally recognised noise prediction algorithms. The CONCAWE algorithm, which is suitable for the assessment of large industrial plants, has been selected for this assessment because it also enables meteorological influences to be assessed.

Inputs to the computer noise model include the following:

- A 5.0 m topographic map for the general area extending from the site to the closest sensitive receptor and major habitable areas.
- The agricultural land surrounding the site has been conservatively modelled with a ground cover factor of 0.5 representative of 'mixed' ground.
- Octave band sound power levels (SWL's) for all acoustically significant plant and equipment proposed to be used on site. Detail of noise source inputs are provided in **Section 7.2**.
- All plant items have been modelled as point sources.
- All plant has been assumed to operate 100% of the time. This assumption is in line with the INP 15 minute assessment interval. Whilst down time can be expected of some plant at times, there will be other periods where all plant operates concurrently for at least 15 minutes.
- Due to the absence of available solar power during night ours, the inverters will not operate during the night period. As such, noise from the solar farm has been assessed to applicable INP day and evening noise criteria.
- Plant siting as indicated by NGH Environmental and Goldwind for the operational facility.
- The predictions also allow for a conservative worst case propagation condition (i.e. including winds in the direction from the source to the receiver and a temperature inversion). It is noted that this is unlikely to occur during typical operating conditions as there will be minimal load on the inverters during the night period when most temperature inversions occur. However, as temperature inversions can sometimes occur during the early morning period noise from the solar farm has been modelled for both calm (CONCAWE Category 4) and enhanced (CONCAWE Category 6) meteorological conditions (see **Section 3.3.3**).

## 7.2 Equipment Sound Power Levels

The $L_{Aeq}$ sound power levels of plant and equipment from existing and proposed operations are given below in **Table 13**.

**Table 13 Equipment Sound Power Levels**

| Group | Plant and Equipment | $L_{Aeq}$ Sound Power Levels (dBA) | Source Height Above Ground Level (m) |
|---|---|---|---|
| Fixed Plant | 4x 2.5 MW Inverters[A] | 92 | 2.6 |
| | 2x Existing Transformer Substations | 90[A] | 2.0 |

Note A: Data based on SMA Solar Technologies document *'White Paper BU-U-019: Sunny Central – Sound Power Measurements on SC 2200 (-US), SC 2500-EV central inverters'* (See **Appendix B**).

Note B: Data based on Appendix A. – High Voltage Transformer Data Sheet, Reference 16 of document *'GULLEN RANGE WINDFARM – 330 / 33 kV Power Transformer Specification – Document Reference: GRWF-TF-SPC02012.08.12_v0.4.docx'* with an additional +5 dBA adjustment to each unit to account for tonal noise at 100 Hz.

Over the night period there will be minimal / zero load on the inverters corresponding to minimal noise impacts. Whilst the transformer substations will operate during the day and night periods due to the operational requirements of the wind farm, this has already been assessed as part of the earlier noise assessment conducted by MDA.

Consequently, due to the daytime operations of the solar farm, the above has been modelled and assessed against the more conservative evening INP noise criteria.

## 7.3 Operational Noise Modelling Results

Operational noise from the solar farm has been assessed to evening INP criteria. **Table 14** shows the operational noise modelling results for both neutral and enhanced propagation conditions which are also presented as Map 1 and Map 2 respectively in **Appendix E**.

**Table 14 Operational Noise Assessment**

| Catchment Area | Receiver | Noise Level – Leq(15minute) (dBA) | | | |
|---|---|---|---|---|---|
| | | Predicted Noise at Dwelling | | Project Criteria Intrusiveness / Amenity | Predicted Exceedance |
| | | Calm | Worst Case | | |
| North of Site | B11 | 10 | 16 | 37 / 45 | 0 |
| | B35 | 13 | 19 | 37 / 45 | 0 |
| | B38 | 13 | 19 | 37 / 45 | 0 |
| | B38A | 15 | 21 | 37 / 45 | 0 |
| | B45 | 14 | 20 | 37 / 45 | 0 |
| | B47 | 14 | 21 | 37 / 45 | 0 |
| | B48 | 15 | 21 | 37 / 45 | 0 |
| | B49 | 13 | 19 | 37 / 45 | 0 |
| Site / South Receptors | PW5 | 22 | 27 | 38 / 43 | 0 |
| | PW7 | 20 | 25 | 38 / 43 | 0 |
| | PW29 | 18 | 24 | 38 / 43 | 0 |
| | PW35 | 13 | 19 | 38 / 43 | 0 |
| | PW36 | 22 | 28 | 38 / 43 | 0 |

Note: The results have been formatted to provide a visual comparison of the predicted noise level at the receptor:

Green The predicted noise levels comply with applicable Project Specific Noise Criteria (i.e. are below both INP Intrusiveness Criteria (RBL + 5 dBA) and the higher Amenity Criteria).

Orange Predicted noise level above INP Intrusiveness criteria but less than Amenity criteria.

Red Predicted noise level above both INP intrusiveness and amenity criteria.

## 7.4 Discussion

The noise modelling results presented in **Table 14** show that noise from the operational solar farm complies with the project noise criteria.

As per the construction noise modelling results, the highest noise emissions are predicted at PW5 with noise levels ranging from 22 dBA to 27 dBA, Leq.

Based on the measured background noise levels (i.e. RBL's typically between 32 and 36 dBA), operational noise from the solar farm will predominantly be inaudible at the closest dwellings.

Given the predicted level of compliance and conservative allowances included in the noise modelling, it is likely that there will be minimal noise impacts during normal operation of the solar farm.

## 7.5 Review of Cumulative Noise from Wind Farm and Solar Farm

As previously noted, noise from the wind farm is subject to specific criteria, which has already been assessed as part of the MDA Report. However, for indicative purposes the cumulative noise from both the wind and solar farm has been predicted assuming worst case propagation conditions for both facilities.

The wind farm noise modelling results have been taken from MDA Report Rp 002 R03 2012154SY *"GULLEN RANGE WIND FARM – Revised Noise Impact Assessment"*, dated 25 September 2013.

The cumulative contribution from both facilities is shown in **Table 14** assessed to evening INP amenity criteria.

**Table 15 Assessment of Cumulative Noise Emissions from Both Projects**

| Catchment Area | Receiver | Noise Level – Leq(15minute) (dBA) | | | | |
|---|---|---|---|---|---|---|
| | | Predicted Worst Case Noise at Dwelling | | | INP Amenity Criteria | Predicted Exceedance |
| | | Wind Farm | Solar Farm | Cumulative | | |
| North of Site | B11 | <35* | 16 | <35 | 45 | 0 |
| | B35 | <35* | 19 | <35 | 45 | 0 |
| | B38 | <35* | 19 | <35 | 45 | 0 |
| | B38A | <35* | 21 | <35 | 45 | 0 |
| | B45 | <35* | 20 | <35 | 45 | 0 |
| | B47 | <35* | 21 | <35 | 45 | 0 |
| | B48 | <35* | 21 | <35 | 45 | 0 |
| | B49 | <35* | 19 | <35 | 45 | 0 |
| Site / South Receptors | PW5 | 36 | 27 | 37 | 43 | 0 |
| | PW7 | 40 | 25 | 40 | 43 | 0 |
| | PW29 | 35 | 24 | 35 | 43 | 0 |
| | PW35 | <35* | 19 | <35 | 43 | 0 |
| | PW36 | 37 | 28 | 38 | 43 | 0 |

Note: The wind farm noise modelling results included above conservatively assume a maximum wind speed of 12 m/s (at hub height) for all turbines. The results marked using an asterisk * were not presented in the MDA Report as the predicted noise level at these receptors was less than 35 dBA.

For all receptors, the cumulative noise from both facilities was found to comply with the amenity criterion. It should be noted that in reality, noise emissions from both facilities will vary significantly depending on wind speed, direction, solar load etc. As such, cumulative noise levels are likely to be much lower than those shown.

# 8 CONCLUSION

This report presents the results of the assessment of potential noise impacts associated with the construction and operation of the proposed 10 MW Gullen Solar farm in southeast NSW.

## 8.1 Construction Noise

The predicted noise levels during the early Stage 1 Site Clearing works indicate elevated noise levels at the closest receptor (PW5) up to 52 dBA, $L_{eq}$ under enhanced propagation conditions. Whilst this equates to a moderate 9 dB exceedance of the daytime ICNG Noise Management Level, it is likely that any noise impacts will be able to be managed given the short term localised nature of the works.

For the other stages the predicted construction noise complied with all criteria under neutral / calm propagation conditions. Under enhanced propagation conditions the noise modelling results indicate small exceedances (up to 4 dBA) of the NML criteria at PW5.

Based on the predicted noise levels and general short term nature of the works it is unlikely that there will be any adverse noise impacts.

Recommendations to help ensure all feasible and reasonable mitigation measured are applied have been provided (refer to **Appendix E**).

## 8.2 Operational Noise

Predicted noise levels during normal operation of the solar farm show that that there will be minimal noise impacts. In fact, at most receptors, noise from the solar farm will predominantly be inaudible above the ambient background noise environment.

Cumulative noise impacts from both the solar farm and existing wind farm were also considered assuming worst case conditions from both facilities to all receptor locations. For all locations, the cumulative noise impacts were below INP Amenity noise criteria.

# Acoustic Terminology

## 1 Sound Level or Noise Level

The terms "sound" and "noise" are almost interchangeable, except that in common usage "noise" is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or $L_P$ are commonly used to represent Sound Pressure Level. The symbol $L_A$ represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is $2 \times 10^{-5}$ Pa.

## 2 "A" Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an "A-weighting" filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

| Sound Pressure Level (dBA) | Typical Source | Subjective Evaluation |
|---|---|---|
| 130 | Threshold of pain | Intolerable |
| 120 | Heavy rock concert | Extremely noisy |
| 110 | Grinding on steel | |
| 100 | Loud car horn at 3 m | Very noisy |
| 90 | Construction site with pneumatic hammering | |
| 80 | Kerbside of busy street | Loud |
| 70 | Loud radio or television | |
| 60 | Department store | Moderate to quiet |
| 50 | General Office | |
| 40 | Inside private office | Quiet to very quiet |
| 30 | Inside bedroom | |
| 20 | Recording studio | Almost silent |

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as "linear", and the units are expressed as dB(lin) or dB.

## 3 Sound Power Level

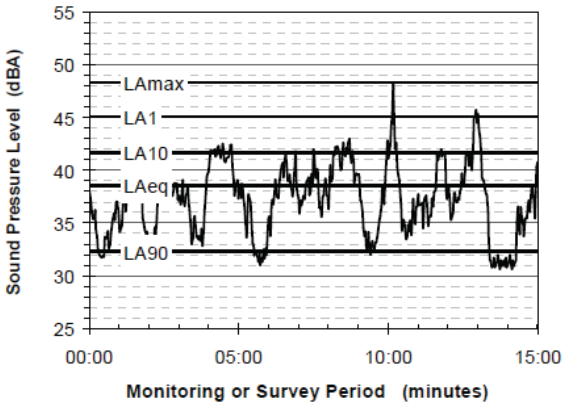
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels,

Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or $L_W$, or by the reference unit $10^{-12}$ W.The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

## 4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels $L_{AN}$, where $L_{AN}$ is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the $L_{A1}$ is the noise level exceeded for 1% of the time, $L_{A10}$ the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.




Of particular relevance, are:

$L_{A1}$ The noise level exceeded for 1% of the 15 minute interval.

$L_{A10}$ The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

$L_{A90}$ The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

$L_{Aeq}$ The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the "repeatable minimum" $L_{A90}$ noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or "average" levels representative of the other descriptors ($L_{Aeq}$, $L_{A10}$, etc).

## 5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than "broad band" noise.

## 6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

## 7 Frequency Analysis

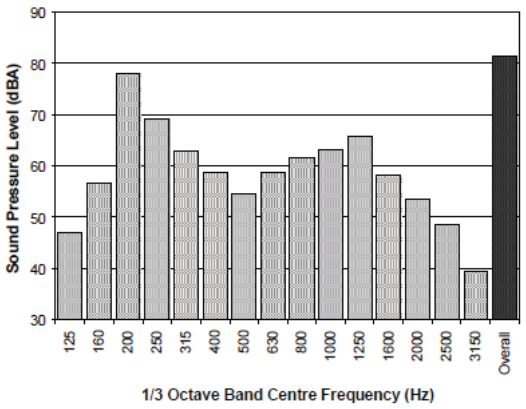
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.




## 8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of "peak" velocity or "rms" velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as "peak particle velocity", or PPV. The latter incorporates "root mean squared" averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log ($V/V_o$), where $V_o$ is the reference level ($10^{-9}$ m/s). Care is required in this regard, as other reference levels may be used by some organizations.

## 9 Human Perception of Vibration

People are able to "feel" vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

## 10 Over-Pressure

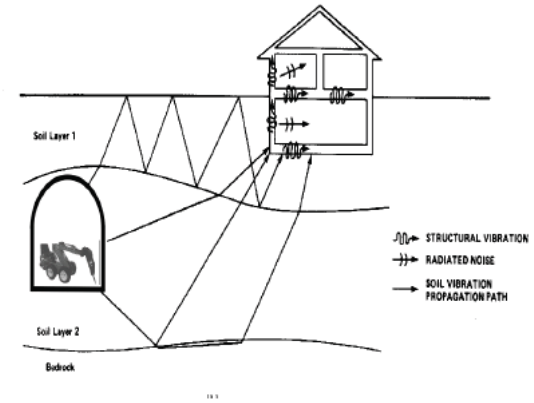
The term "over-pressure" is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

## 11 Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed "structure-borne noise", "ground-borne noise" or "regenerated noise". This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.




The term "regenerated noise" is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise.

SMA WHITE PAPER BU-U-019: SUNNY CENTRAL – SOUND POWER MEASUREMENTS ON SC 2200 (-US), SC 2500-EV CENTRAL INVERTERS

**Result of Measurements**

The following rating levels can be determined from the sound power measurements performed:

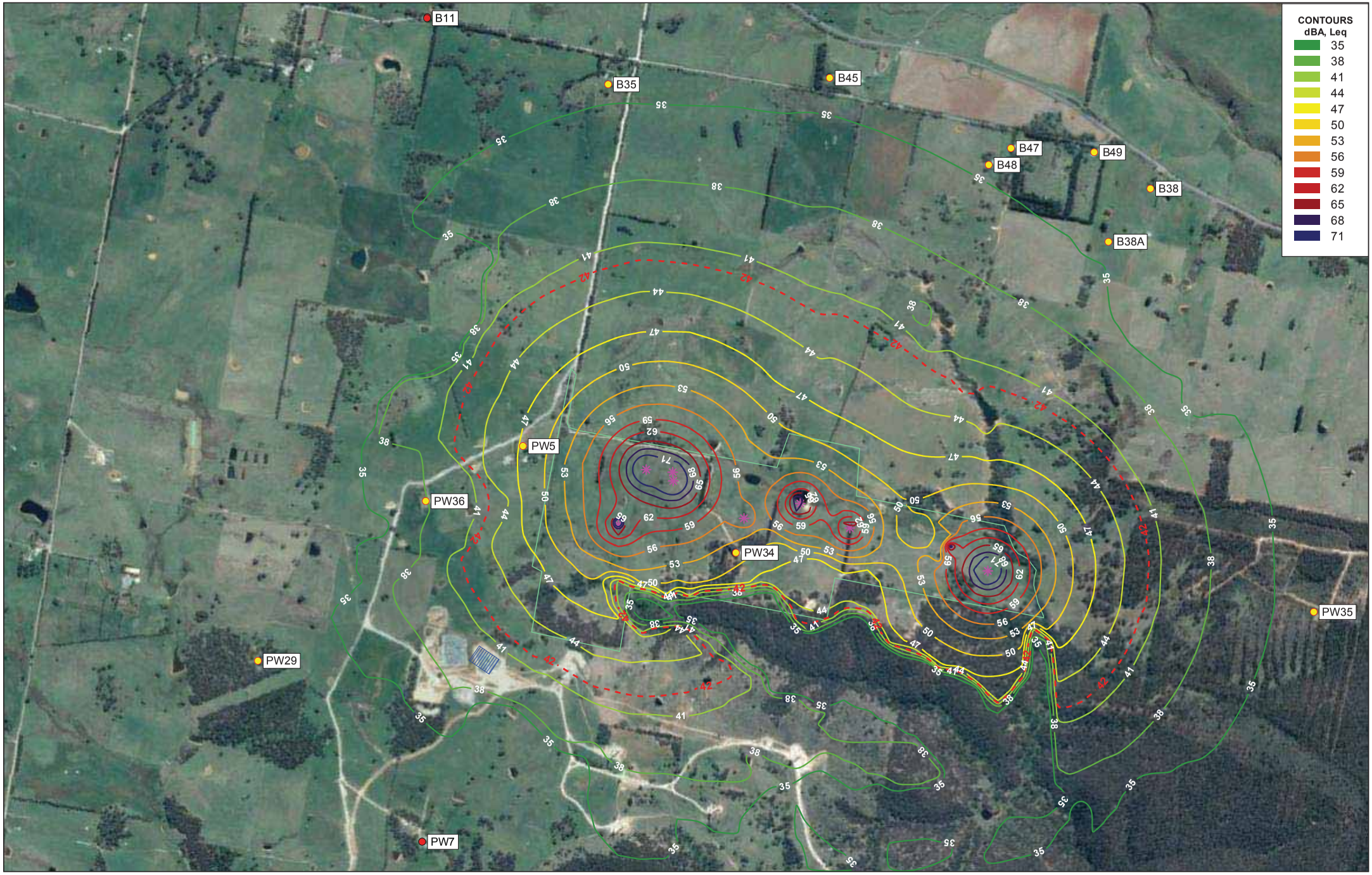
| Inverter type | Sound power level mean value $L_{WA}$ |
|---|---|
| SC 2200 | 94 |
| SC 2200-US | 94 |
| SC 2500-EV | 92 |

The following tables show the selected distances from the inverter and their corresponding sound pressure levels $L_{pA}$ in dB(A) at nominal AC power.

| Distance | SC 2200 | SC 2200-US | SC 2500-EV |
|---|---|---|---|
| 1 m | 79 | 79 | 77 |
| 10 m | 66 | 66 | 64 |
| 20 m | 60 | 60 | 58 |
| 30 m | 56 | 56 | 55 |
| 40 m | 54 | 54 | 52 |
| 50 m | 52 | 52 | 50 |
| 60 m | 50 | 50 | 49 |
| 70 m | 49 | 49 | 47 |
| 80 m | 48 | 48 | 46 |
| 90 m | 47 | 47 | 45 |
| 100 m | 46 | 46 | 44 |

**Information:**

The detailed test report may be requested from SMA Solar Technology AG if necessary.

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**SCALE**

0 100 200 400 600 800 1000 m

**ORIENTATION**

N

**LEGEND**

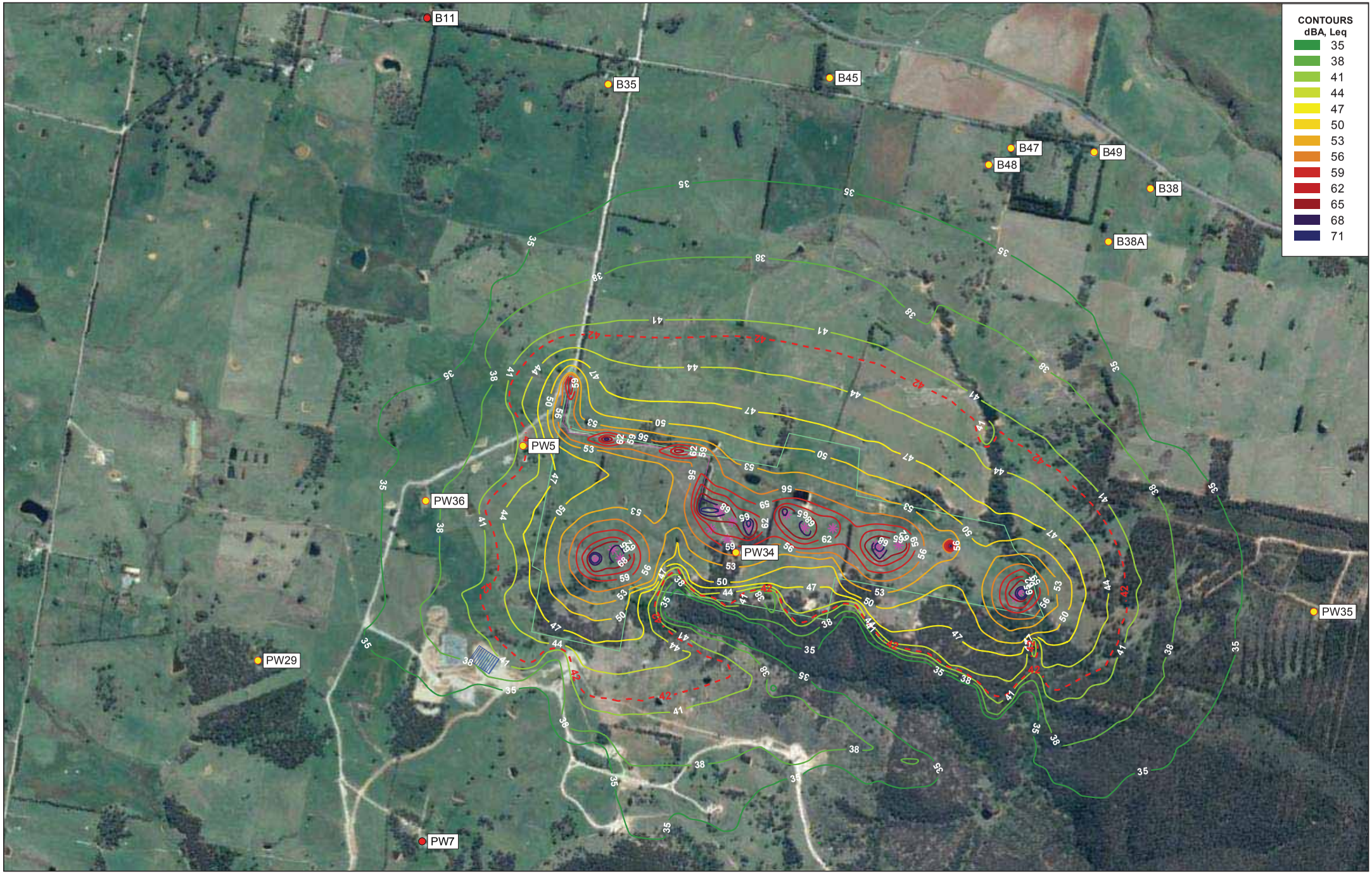
- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 1 - Calm Weather: Site Preparation, Clearing & Demolition |

Date: 9/05/2016
Project No.: 640.10935
Report No.: 640.10935-R1
Prediction Method: CONCAWE
Prepared By: IF
Prediction Height:2 m

**APPENDIX**
C

**MAP NO.**
001

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**ORIENTATION**

N

**LEGEND**

- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 2 - Calm Weather: Establish Site Compound, Access Roads & Deliveries |

| | |
|---|---|
| Date: | 9/05/2016 |
| Project No.: | 640.10935 |
| Report No.: | 640.10935-R1 |
| Prediction Method: | CONCAWE |
| Prepared By: | IF |
| Prediction Height: | 2 m |

**APPENDIX**
C

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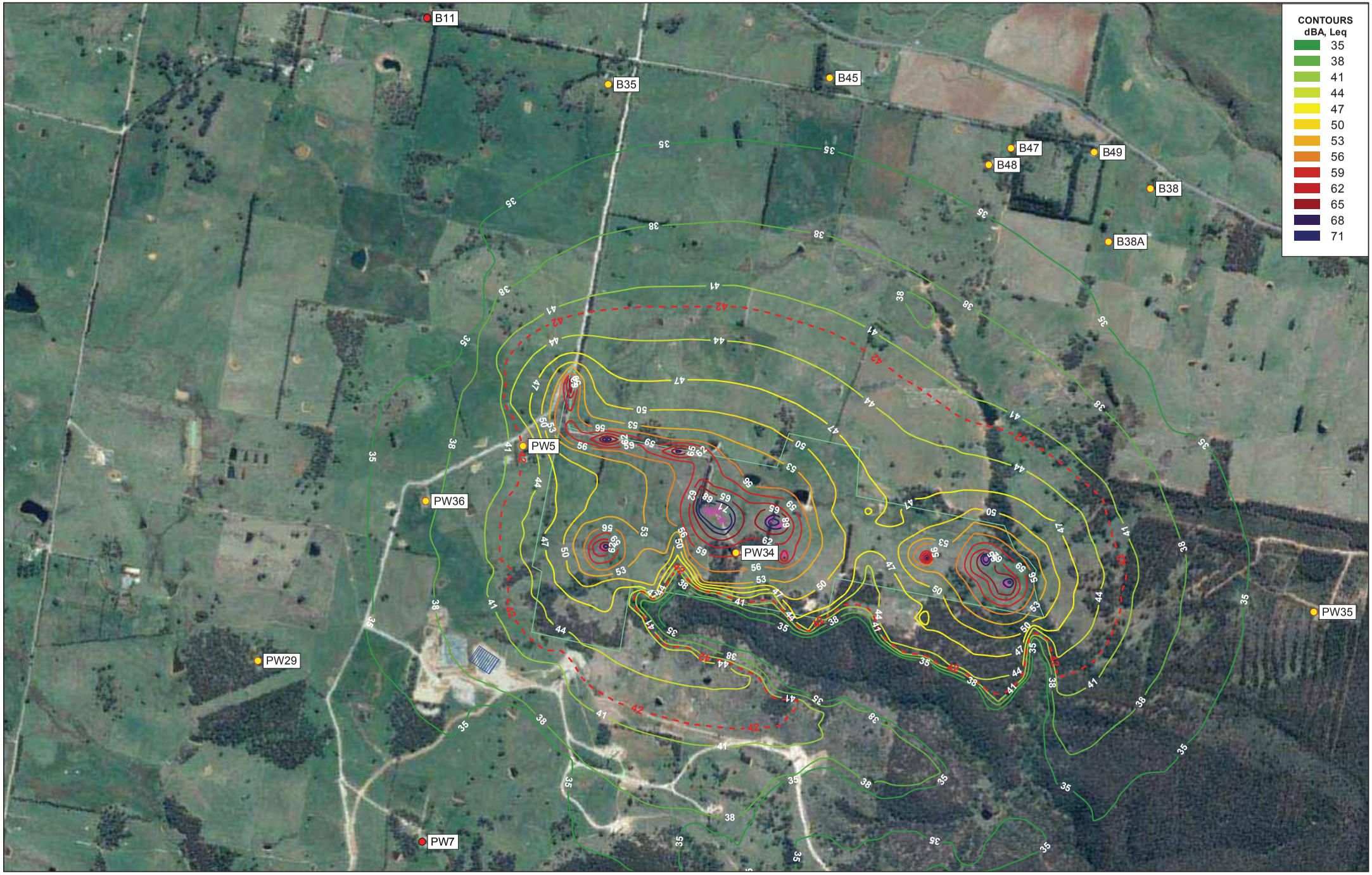
002

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**SCALE**
0 100 200 400 600 800 1000 m

**ORIENTATION**
N

**LEGEND**
- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 3 - Calm Weather: Installation of Foundations |

Date: 9/05/2016
Project No.: 640.10935
Report No.: 640.10935-R1
Prediction Method: CONCAWE
Prepared By: IF
Prediction Height:2 m

**APPENDIX**
C

**MAP NO.**
003


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**SCALE**

0 100 200 400 600 800 1000 m

**ORIENTATION**

N

**LEGEND**

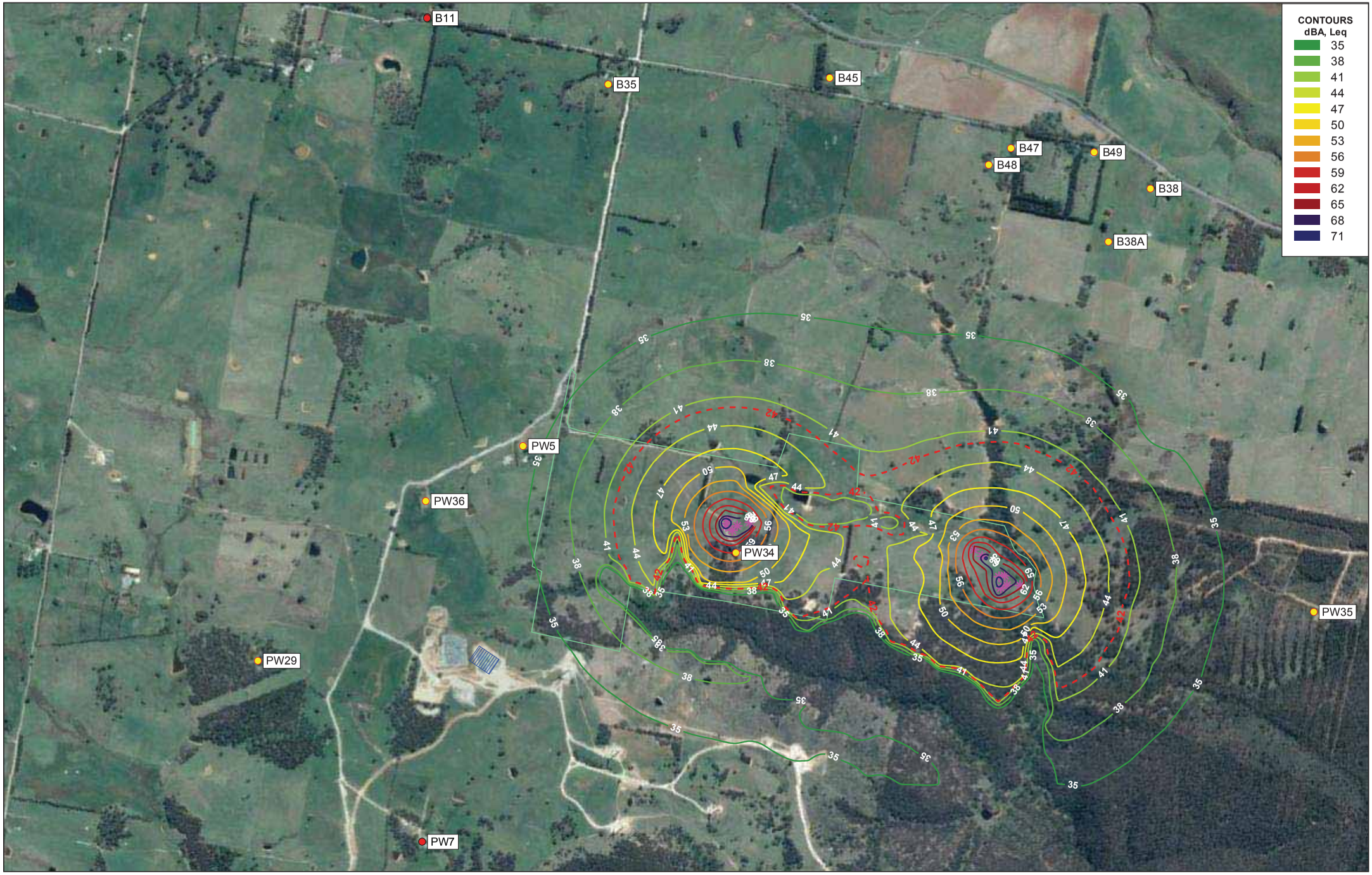
- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 4 - Calm Weather: Installation of Underground Cabling |

| | |
|---|---|
| Date: | 9/05/2016 |
| Project No.: | 640.10935 |
| Report No.: | 640.10935-R1 |
| Prediction Method: | CONCAWE |
| Prepared By: | IF |
| Prediction Height: | 2 m |

**APPENDIX**
C

**MAP NO.**
004

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**SCALE**

0 100 200 400 600 800 1000 m

**ORIENTATION**

N

**LEGEND**

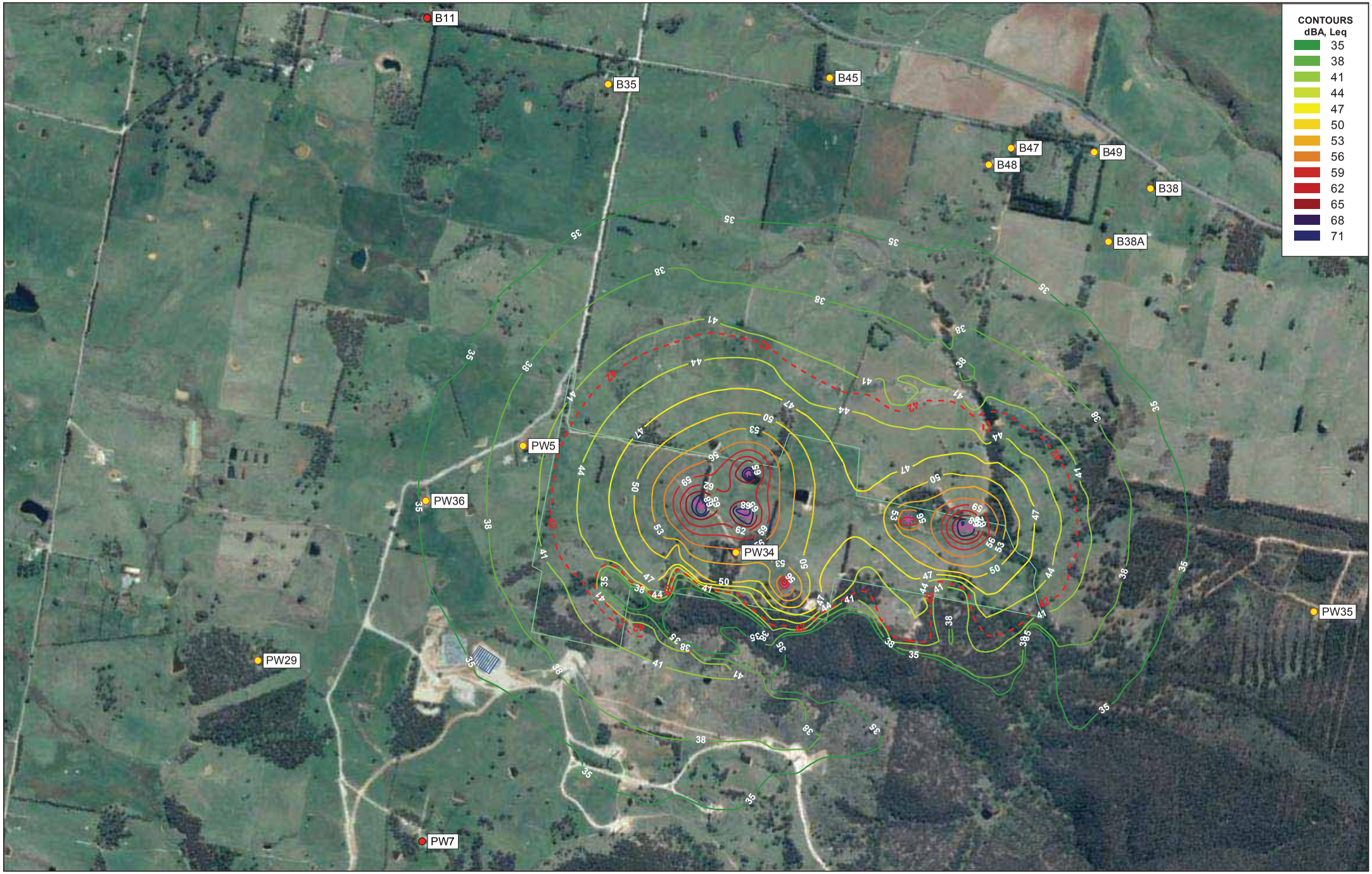
- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 5 - Calm Weather:<br>Assebly of Panel Frame & Mounts / Transformers |

| | |
|---|---|
| Date: | 9/05/2016 |
| Project No.: | 640.10935 |
| Report No.: | 640.10935-R1 |
| Prediction Method: | CONCAWE |
| Prepared By: | IF |
| Prediction Height: | 2 m |

**APPENDIX**
C

**MAP NO.**
005

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**SCALE**

0 100 200 400 600 800 1000 m

**ORIENTATION**

N

**LEGEND**

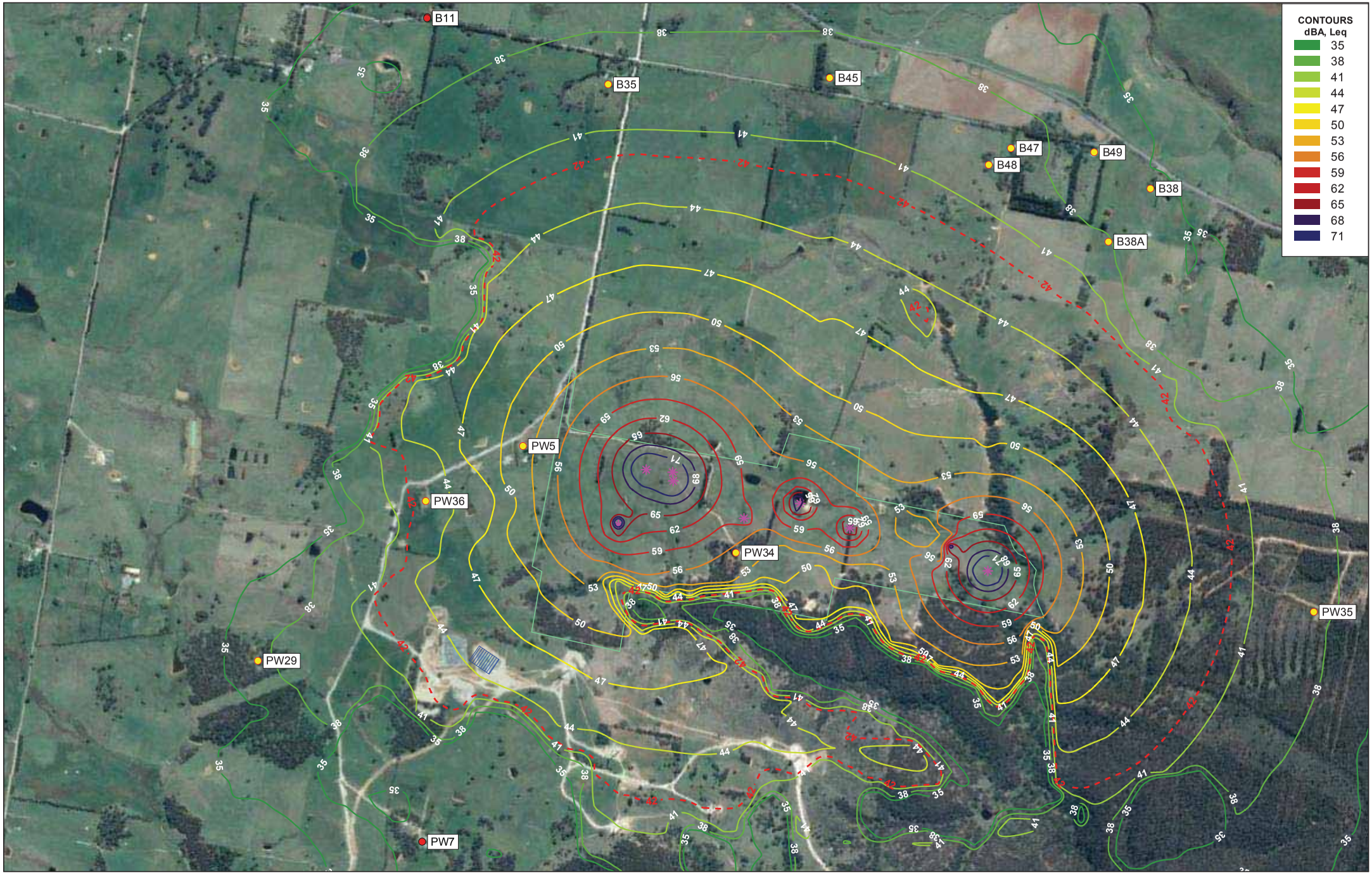
- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 6 - Calm Weather:<br>Site Rehab / Removal of Construction Facilities |

Date: 9/05/2016
Project No.: 640.10935
Report No.: 640.10935-R1
Prediction Method: CONCAWE
Prepared By: IF
Prediction Height:2 m

**APPENDIX**
C

**MAP NO.**
006

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**SCALE**

0 100 200 400 600 800 1000 m

**ORIENTATION**

N

**LEGEND**

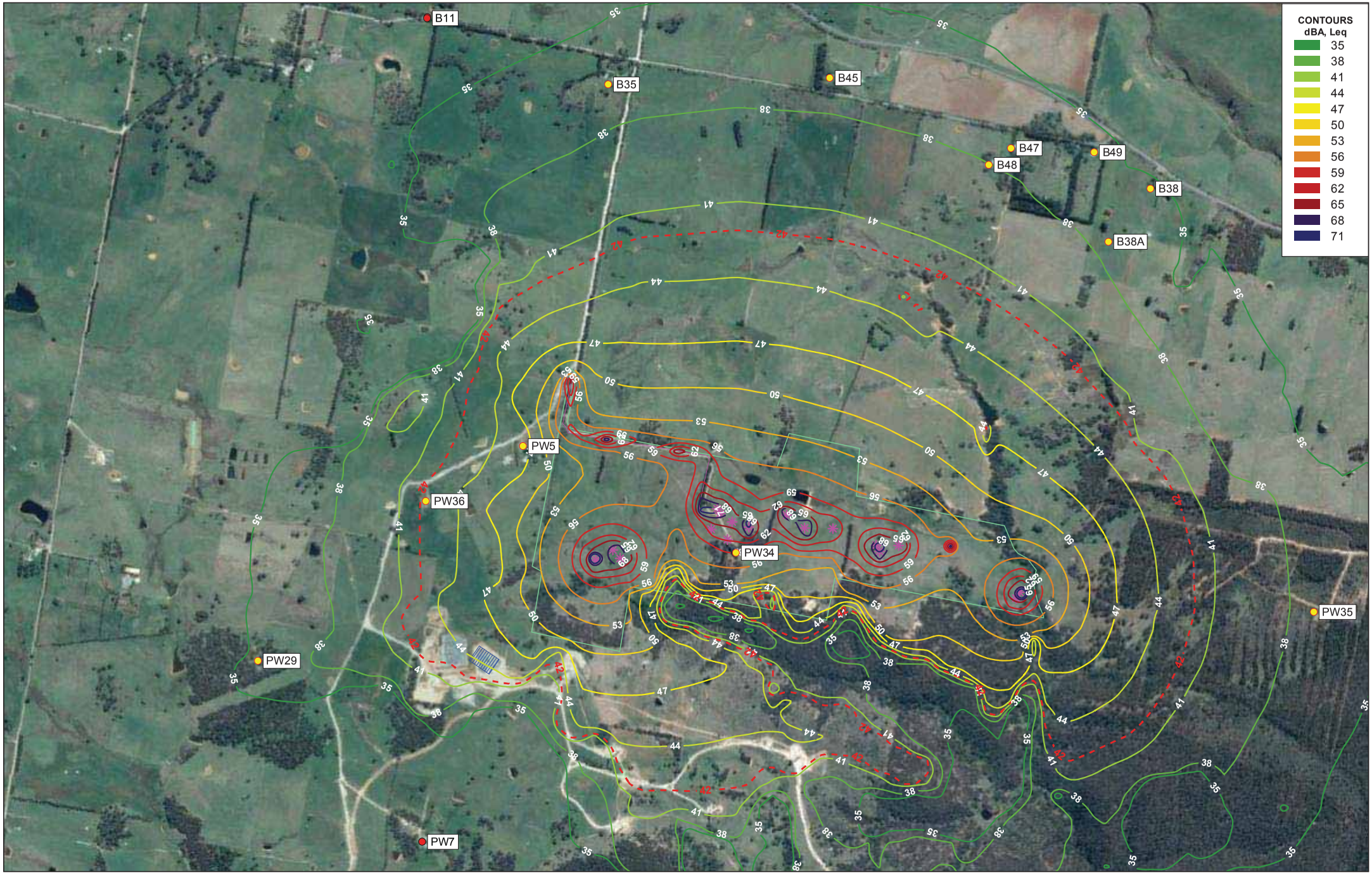
- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 1 - Worst Case Weather: Site Preparation, Clearing & Demolition |

Date: 9/05/2016
Project No.: 640.10935
Report No.: 640.10935-R1
Prediction Method: CONCAWE
Prepared By: IF
Prediction Height:2 m

**APPENDIX**
D

**MAP NO.**
001

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**SCALE**
0 100 200 400 600 800 1000 m

**ORIENTATION**
N

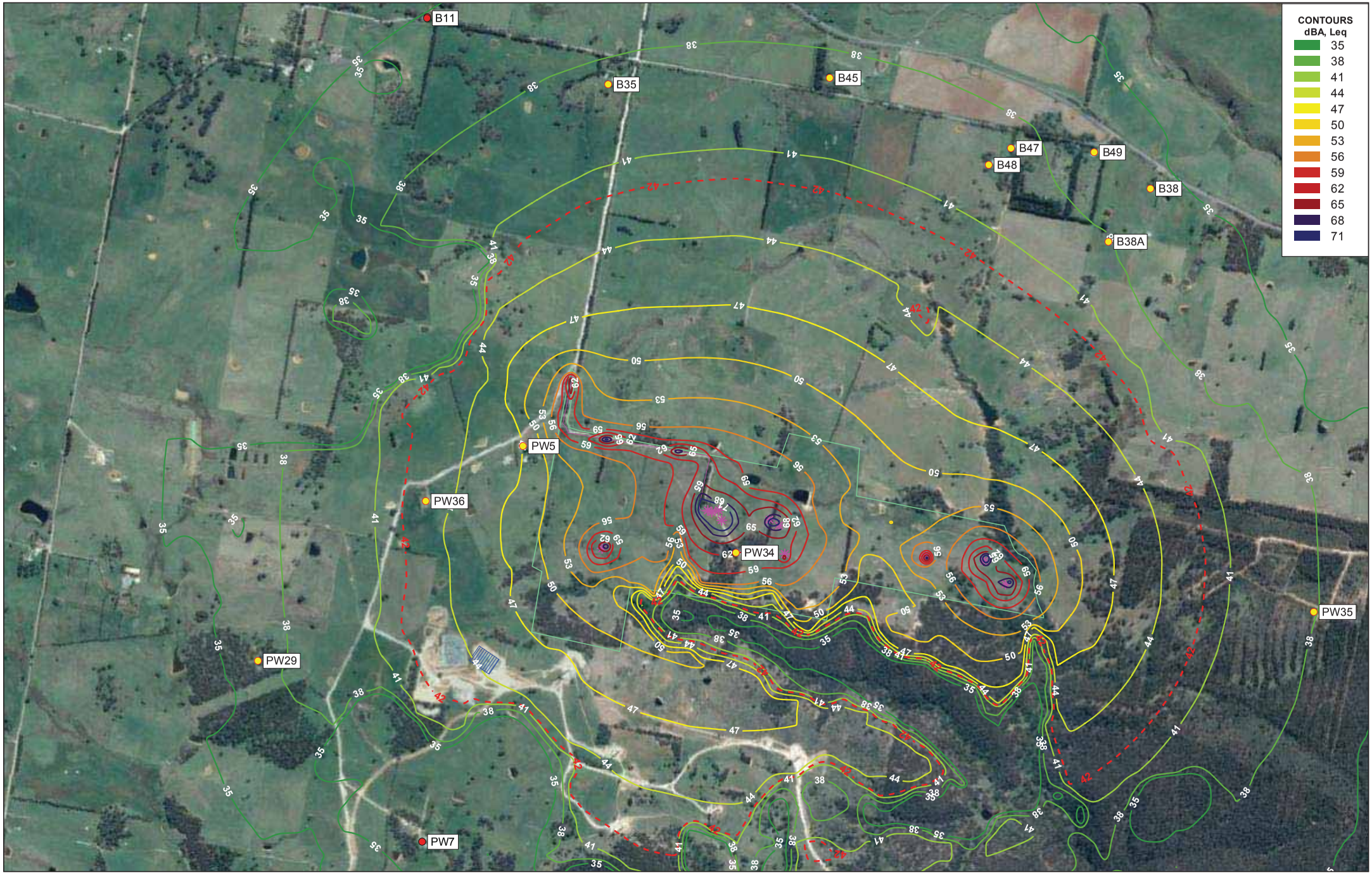
**LEGEND**
- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 2 - Worst Case Weather: Build Site Compound, Access Roads & Deliveries |

| | |
|---|---|
| Date: | 9/05/2016 |
| Project No.: | 640.10935 |
| Report No.: | 640.10935-R1 |
| Prediction Method: | CONCAWE |
| Prepared By: | IF |
| Prediction Height: | 2 m |

**APPENDIX**
D

**MAP NO.**
002

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BALWYN NORTH
VIC 3104
AUSTRALIA
T: 61 3 9249 9400
F: 61 3 9249 9499
www.slrconsulting.com



**SCALE**

0 100 200 400 600 800 1000 m

**ORIENTATION**

N

**LEGEND**

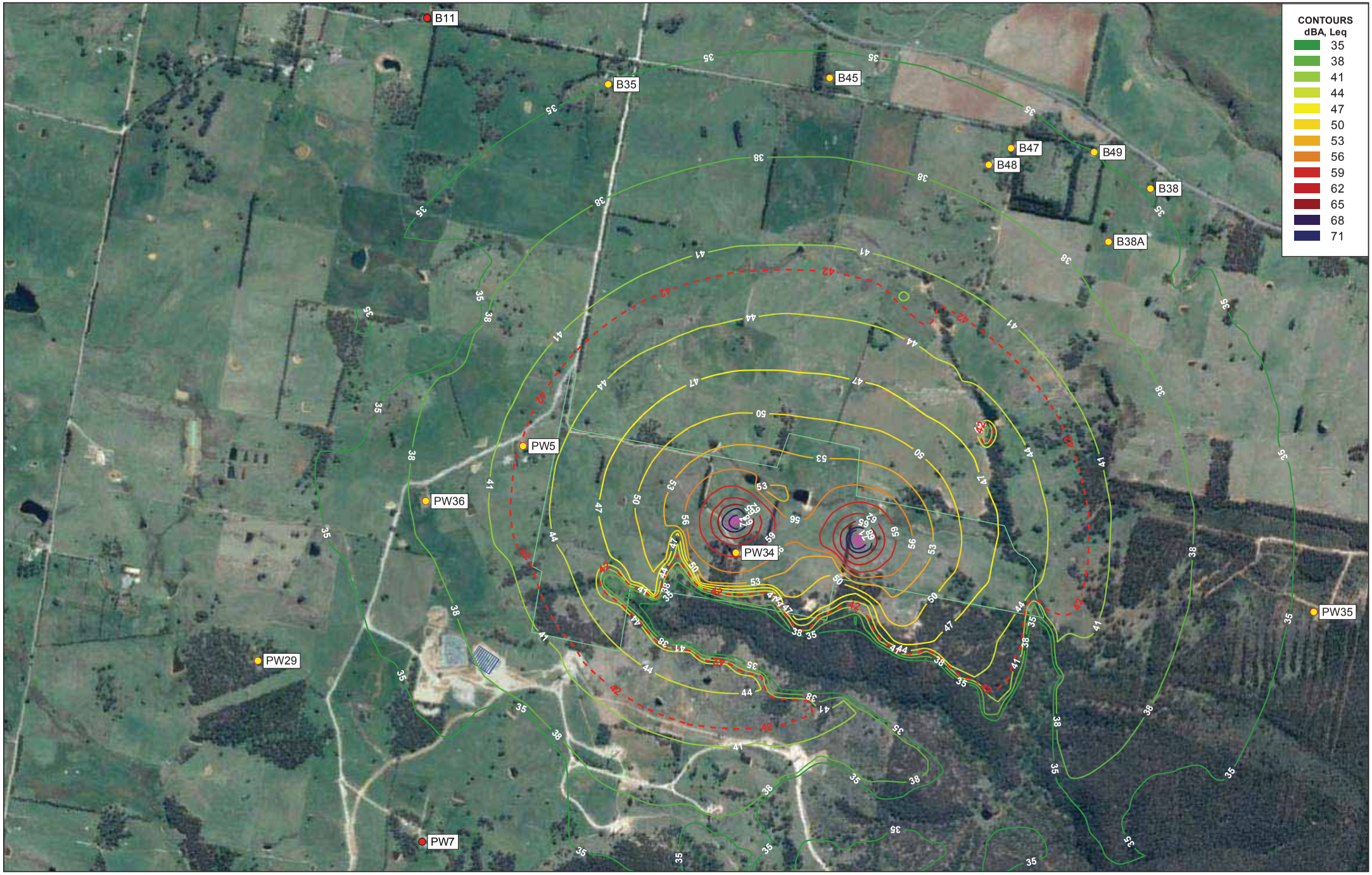
- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 3 - Worst Case Weather: Installation of Foundations |

Date: 9/05/2016
Project No.: 640.10935
Report No.: 640.10935-R1
Prediction Method: CONCAWE
Prepared By: IF
Prediction Height:2 m

**APPENDIX**
**D**

**MAP NO.**
003

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**SCALE**

0 100 200 400 600 800 1000 m

**ORIENTATION**

N

**LEGEND**

- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 4 - Worst Case Weather: Installation of Underground Cabling |

Date: 9/05/2016
Project No.: 640.10935
Report No.: 640.10935-R1
Prediction Method: CONCAWE
Prepared By: IF
Prediction Height:2 m

**APPENDIX**
**D**

**MAP NO.**
004


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VIC 3104
AUSTRALIA
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F: 61 3 9249 9499
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**SCALE**

0 100 200 400 600 800 1000 m

**ORIENTATION**

N

**LEGEND**

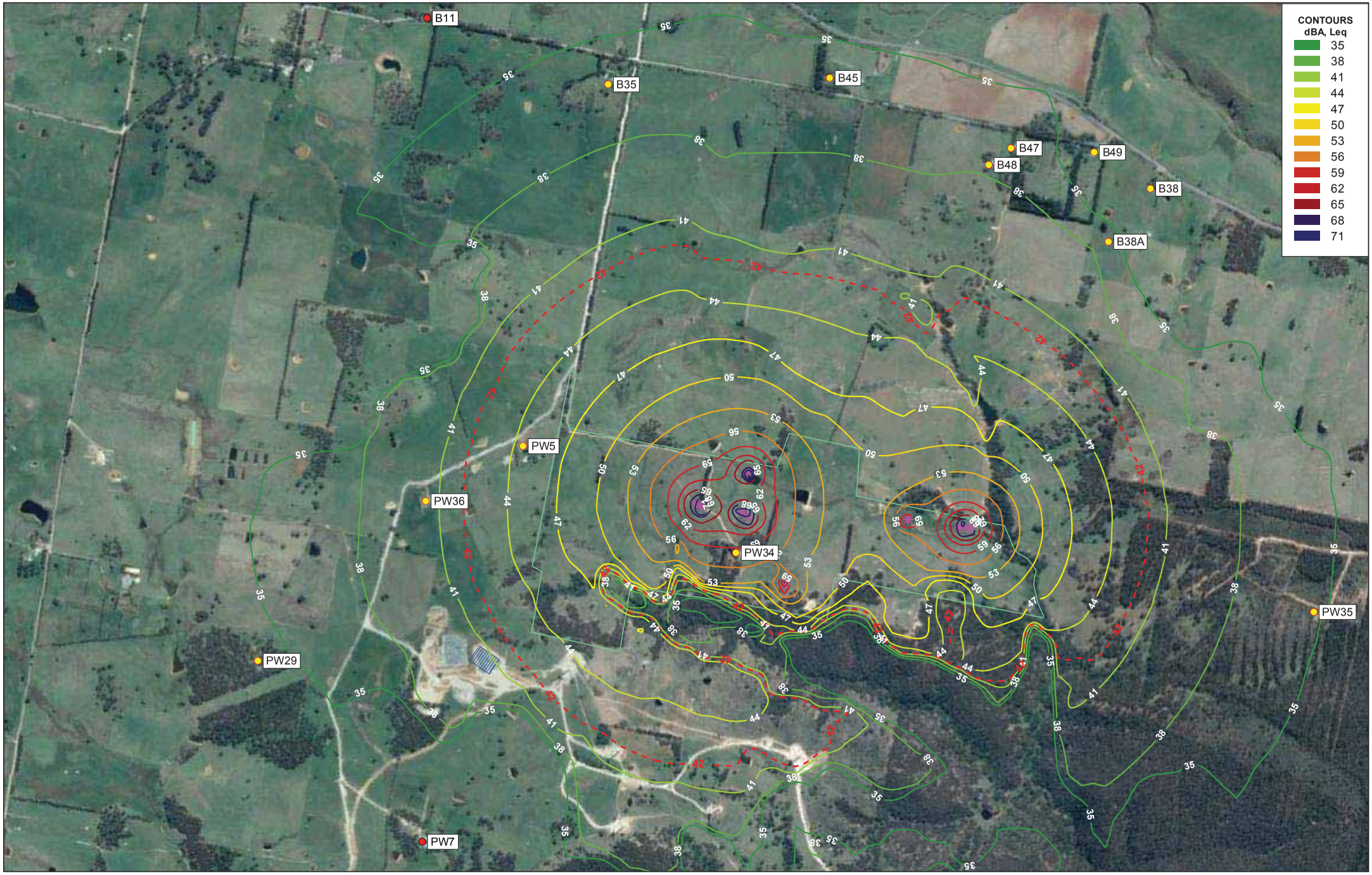
- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 5 - Worst Case Weather: Assebly of Panel Frame & Mounts / Transformers |

| | |
|---|---|
| Date: | 9/05/2016 |
| Project No.: | 640.10935 |
| Report No.: | 640.10935-R1 |
| Prediction Method: | CONCAWE |
| Prepared By: | IF |
| Prediction Height: | 2 m |

**APPENDIX**
**D**

**MAP NO.**
005

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**SCALE**
0 100 200 400 600 800 1000 m

**ORIENTATION**
N

**LEGEND**
- Construction plant
- Area source
- Main building
- Point receiver
- Receiver / BG monitoring loc.
- Noise Affected NML
- Solar Plant Site Boundary
- Gullen Range Substation

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Construction Stage 6 - Worst Case Weather: Site Rehab / Removal of Construction Facilities |

| | |
|---|---|
| Date: | 9/05/2016 |
| Project No.: | 640.10935 |
| Report No.: | 640.10935-R1 |
| Prediction Method: | CONCAWE |
| Prepared By: | IF |
| Prediction Height: | 2 m |

**APPENDIX**
D

**MAP NO.**
006


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**SCALE**
0 100 200 400 600 800 1000 m

**ORIENTATION**
N

**LEGEND**
- Point source
- Point receiver
- Receiver / BG mon.loc.
- Solar Plant Site Boundary
- Gullen Range Substation
- INP Criteria
- Cabling
- Solar Panels

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Noise from Operational Solar Plant<br>Calm / Neutral Weather Conditions |

| | |
|---|---|
| Date: | 9/05/2016 |
| Project No.: | 640.10935 |
| Report No.: | 640.10935-R1 |
| Prediction Method: | CONCAWE |
| Prepared By: | IF |
| Prediction Height: | 2 m |

**APPENDIX**
E

**MAP NO.**
001


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BALWYN NORTH
VIC 3104
AUSTRALIA
T: 61 3 9249 9400
F: 61 3 9249 9499
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**SCALE**
0 100 200 400 600 800 1000 m

**ORIENTATION**
N

**LEGEND**
- Point source
- Point receiver
- Receiver / BG mon.loc.
- Solar Plant Site Boundary
- Gullen Range Substation
- INP Criteria
- Cabling
- Solar Panels

| | |
|---|---|
| **PROJECT** | Gullen Solar Farm |
| **CLIENT** | NGH Environmental |
| **DESCRIPTION** | Noise from Operational Solar Plant<br>Worst Case / Enhanced Weather Conditions |

| | |
|---|---|
| Date: | 9/05/2016 |
| Project No.: | 640.10935 |
| Report No.: | 640.10935-R1 |
| Prediction Method: | CONCAWE |
| Prepared By: | IF |
| Prediction Height: | 2 m |

**APPENDIX**
E

**MAP NO.**
002

GENERAL NOISE MANAGEMENT / MITIGATION MEASURES

**Adoption of Universal Work Practices**

- Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration.
- Regular identification of noisy activities and adoption of improvement techniques.
- Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents.
- Where possible, avoiding the use of equipment that generates impulsive noise.
- Minimising the need for vehicle reversing for example (particularly at night), by arranging for one-way site traffic routes.
- Use of broadband audible alarms on vehicles and elevating work platforms used on site.
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact.
- Minimising truck movements.

**Plant and Equipment**

- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
- Selecting plant and equipment with low vibration generation characteristics.
- Operating plant and equipment in the quietest and most efficient manner.

**On Site Noise Mitigation**

- Maximising the distance between noise activities and noise sensitive land uses.
- Installing purpose built noise barriers, acoustic sheds and enclosures.

**Work Scheduling**

- Providing respite periods which could include restricting very noisy activities (e.g. piling) to the daytime, restricting the number of nights that after-hours work is conducted near residences or by determining any specific requirements.
- Scheduling work to coincide with non-sensitive periods.
- Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers.
- Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.
- Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.

**Source Noise Control Strategies**

Some ways of controlling noise at the source are:

- Where reasonably practical, noisy plant or processes should be replaced by less noisy alternatives.
- Modify existing equipment: Engines and exhausts are typically the dominant noise sources on mobile plant such as cranes, graders, excavators, trucks, etc. In order to minimise noise emissions, residential grade mufflers should be fitted on all mobile plant utilised on site.
- Use of siting of equipment: Siting noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
- Regular and effective maintenance.

**Noise Barrier Control Strategies**

Temporary noise barriers are recommended where feasible, between the noise sources and all nearby potentially affected noise sensitive receivers, wherever possible. Typically, 7 dBA to 15 dBA of attenuation can be achieved with a well-constructed barrier. Specific strategies include:

- Orientation of the noisy equipment whereby the least noisy side of the equipment is facing the closest receiver.
- The positioning of any site huts/maintenance sheds adjacent to the noisy equipment, in the direction of the closest receiver.

BOX 124E
(AJ860438)

NEW SOUTH WALES

# CERTIFICATE OF TITLE

REAL PROPERTY ACT, 1900

| TORRENS TITLE REFERENCE | |
|---|---|
| 1/1196222 | |
| EDITION | DATE OF ISSUE |
| 4 | 2/10/2015 |
| CERTIFICATE AUTHENTICATION CODE | |
| XFY9-QQ-52GN | |

I certify that the person described in the First Schedule is the registered proprietor of an estate in fee simple (or such other estate or interest as is set forth in that Schedule) in the land within described subject to such exceptions, encumbrances, interests and entries as appear in the Second Schedule and to any additional entries in the Folio of the Register.

REGISTRAR GENERAL

REGISTRAR GENERAL NEW SOUTH WALES

LAND
----
LOT 1 IN DEPOSITED PLAN 1196222
AT BANNISTER.
LOCAL GOVERNMENT AREA: UPPER LACHLAN SHIRE.
PARISH OF POMEROY COUNTY OF ARGYLE
TITLE DIAGRAM: DP1196222

FIRST SCHEDULE
---
GOULBURN LAND PTY LTD (T AJ860438)

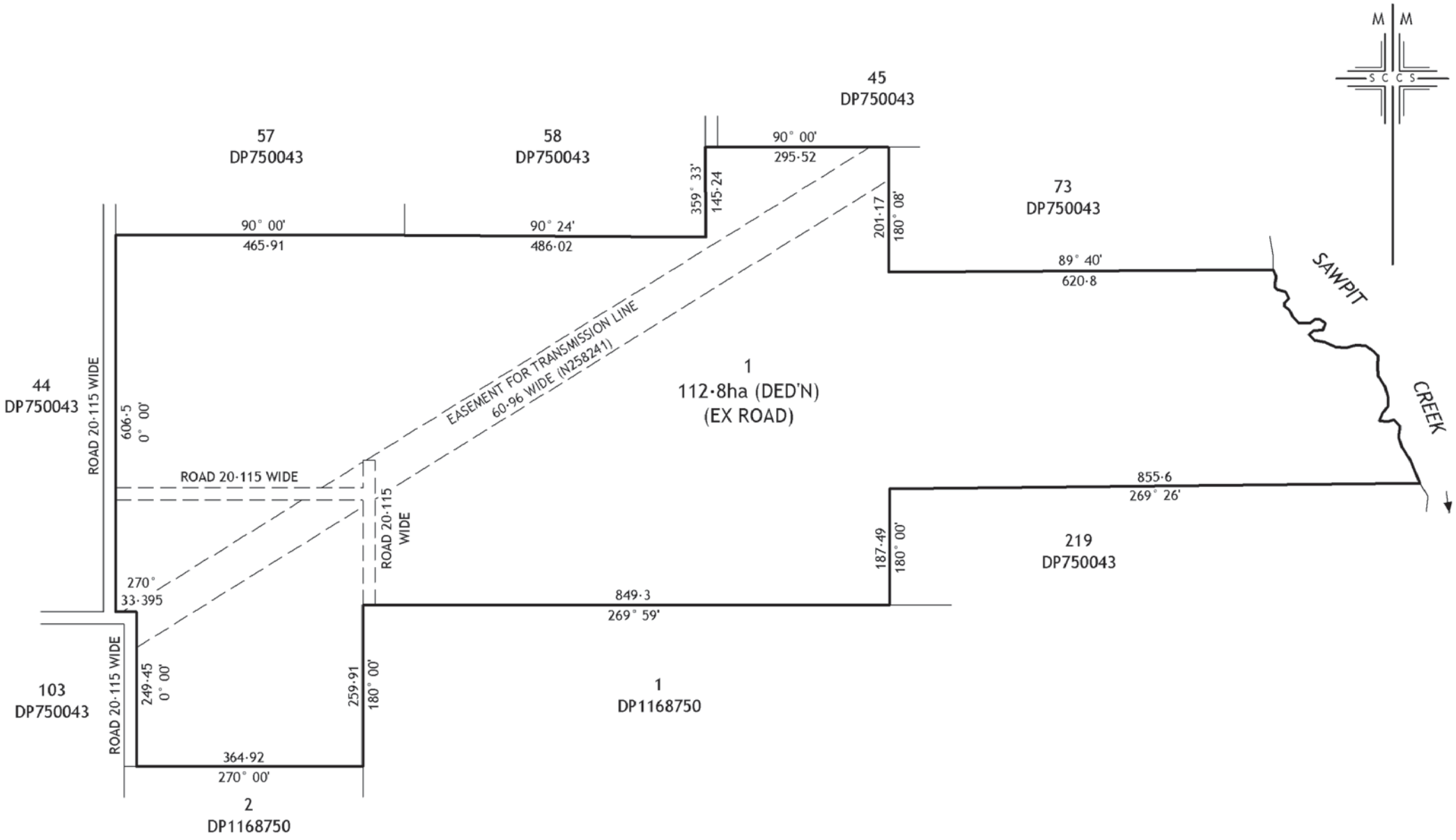
SECOND SCHEDULE
---
1. LAND EXCLUDES MINERALS AND IS SUBJECT TO RESERVATIONS AND CONDITIONS IN FAVOUR OF THE CROWN - SEE CROWN GRANT(S)
2. LAND EXCLUDES THE ROAD(S) SHOWN IN THE TITLE DIAGRAM
3. N258421 EASEMENT FOR TRANSMISSION LINE AFFECTING THE PART(S) SHOWN SO BURDENED IN THE TITLE DIAGRAM
3380026 EASEMENT NOW VESTED IN NEW SOUTH WALES ELECTRICITY TRANSMISSION AUTHORITY

**** END OF CERTIFICATE ****





6200478




| | | | |
|---|---|---|---|
| Surveyor: GA Flood<br>Date of Survey: 10/04/2014<br>Surveyor's Ref: 22576<br>2014M7100(560)Comp | PLAN OF CONSOLIDATION OF LOTS 2, 56, 93, 106 & 125 DP750043 AND LOTS 1 & 2 DP132144 | LGA: UPPER LACHLAN<br>Locality: BANNISTER<br>Subdivision No: —<br>Lengths are in metres. Reduction Ratio 1:6000 | Registered<br>16.5.2014 | DP1196222 |

10 20 30 40 50 Table of mm 90 100 110 120 130 140



DP1196222

PLAN FORM 6 (2013) WARNING: Creasing or folding will lead to rejection ePlan

# DEPOSITED PLAN ADMINISTRATION SHEET

Sheet 1 of 2 sheet(s)

Office Use Only

Registered: 16.5.2014

Title System: TORRENS

Purpose: SUBDIVISION

Office Use Only

DP1196222

**PLAN OF CONSOLIDATION OF LOTS 2, 56, 93, 106 & 125 DP750043 AND LOTS 1 & 2 DP132144**

LGA: UPPER LACHLAN

Locality: BANNISTER

Parish: POMEROY

County: ARGYLE

## Crown Lands NSW/Western Lands Office Approval

I, ..... (Authorised Officer) in approving this plan certify that all necessary approvals in regard to the allocation of the land shown herein have been given.

Signature: .....

Date: .....

File Number: .....

Office: .....

## Subdivision Certificate

I, .....

*Authorised Person/*General Manager/*Accredited Certifier, certify that the provisions of s.109J of the *Environmental Planning and Assessment Act 1979* have been satisfied in relation to the proposed subdivision, new road or reserve set out herein.

Signature: .....

Accreditation number: .....

Consent Authority: .....

Date of endorsement: .....

Subdivision Certificate number: .....

File number: .....

*Strike through if inapplicable.

## Survey Certificate

I, Gilbert Anthony Flood

of PO Box 142 GOULBURN NSW 2580 (Tel 02 4822 1366)

a surveyor registered under the *Surveying and Spatial Information Act 2002*, certify that:

~~*(a) The land shown in the plan was surveyed in accordance with the *Surveying and Spatial Information Regulation 2012*, is accurate and the survey was completed on .....~~

~~*(b) The part of the land shown in the plan (*being/*excluding ^ .....~~ ~~.....)~~ ~~was surveyed in accordance with the *Surveying and Spatial Information Regulation 2012*, is accurate and the survey was completed on, ..... the part not surveyed was compiled in accordance with that Regulation.~~

*(c) The land shown in this plan was compiled in accordance with the *Surveying and Spatial Information Regulation 2012.*

Signature: Dated: 15/04/2014

Surveyor ID: 1047

Datum Line: N/A

Type: ~~*Urban~~/*Rural

The terrain is *Level-Undulating / ~~*Steep-Mountainous.~~

*Strike through if inapplicable.

^Specify the land actually surveyed or specify any land shown in the plan that is not the subject of the survey.

Statements of intention to dedicate public roads create public reserves and drainage reserves, acquire/resume land.

Plans used in the preparation of ~~survey~~/compilation.

257-2121 809-2121 464-1876 969-642 2602-2121
DP132144
PLANS ANNEXED TO LAND GRANTS VOL 3816 FOLIO 163 & VOL 1773 FOLIO 132

If space is insufficient continue on PLAN FORM 6A

Signatures, Seals and Section 88B Statements should appear on PLAN FORM 6A

Surveyor's Reference: 22576 2014M7100(560)Comp

PLAN FORM 6A (2012) WARNING: Creasing or folding will lead to rejection ePlan

# DEPOSITED PLAN ADMINISTRATION SHEET



Office Use Only

Registered: 16.5.2014

Office Use Only

DP1196222

**PLAN OF CONSOLIDATION OF LOTS 2, 56, 93, 106 & 125 DP750043 AND LOTS 1 & 2 DP132144**

This sheet is for the provision of the following information as required:

- A schedule of lots and addresses - See 60(c) *SSI Regulation 2012*
- Statements of intention to create and release affecting interests in accordance with section 88B *Conveyancing Act 1919*
- Signatures and seals- see 195D *Conveyancing Act 1919*
- Any information which cannot fit in the appropriate panel of sheet 1 of the administration sheets.

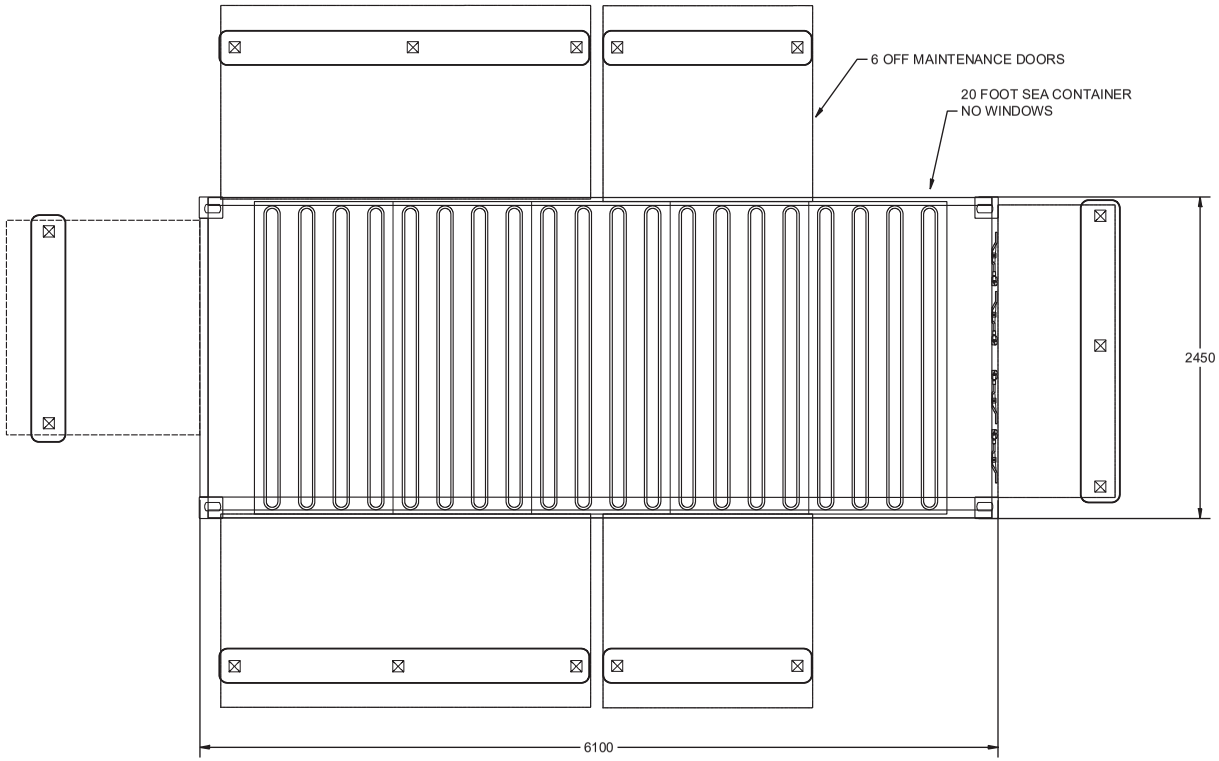
Subdivision Certificate number: .....

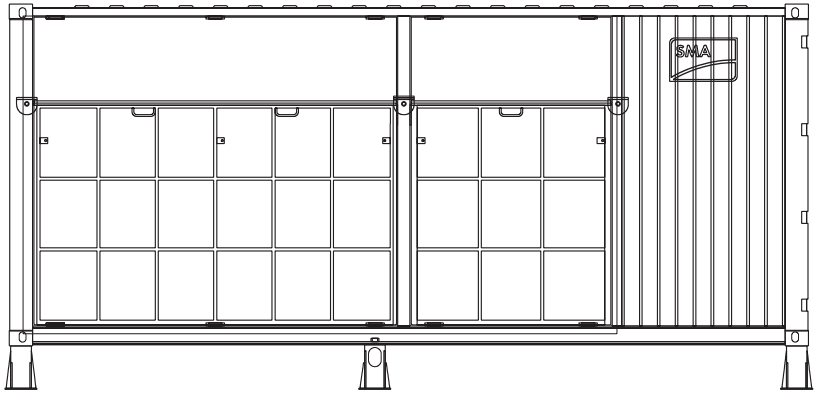
Date of Endorsement: .....

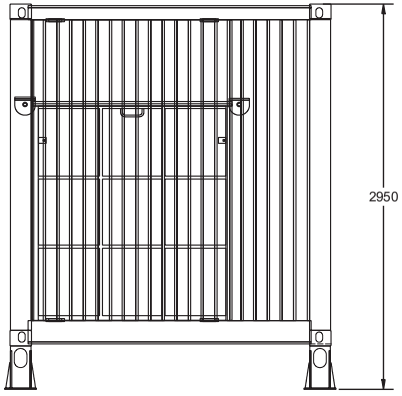
| STREET ADDRESSES | | | | |
|---|---|---|---|---|
| LOT | STREET No. | STREET NAME | STREET TYPE | LOCALITY |
| 1 | 131 | STORRIERS | LANE | BANNISTER |

If space is insufficient use additional annexure sheet

Surveyor's Reference: 22576 2014M7100(560)Comp




Balance UTILITY SOLUTIONS

| REV. | DATE | DESCRIPTION | DRWN. | CHKD. | APPR. |
|---|---|---|---|---|---|
| A1 | 11.05.16 | ISSUED FOR REVIEW | DW | | |

THIRD ANGLE PROJECTION



TITLE

# GULLEN PV FARM
# GENERAL ARRANGEMENT
# INVERTER LAYOUT DETAILS

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN mm

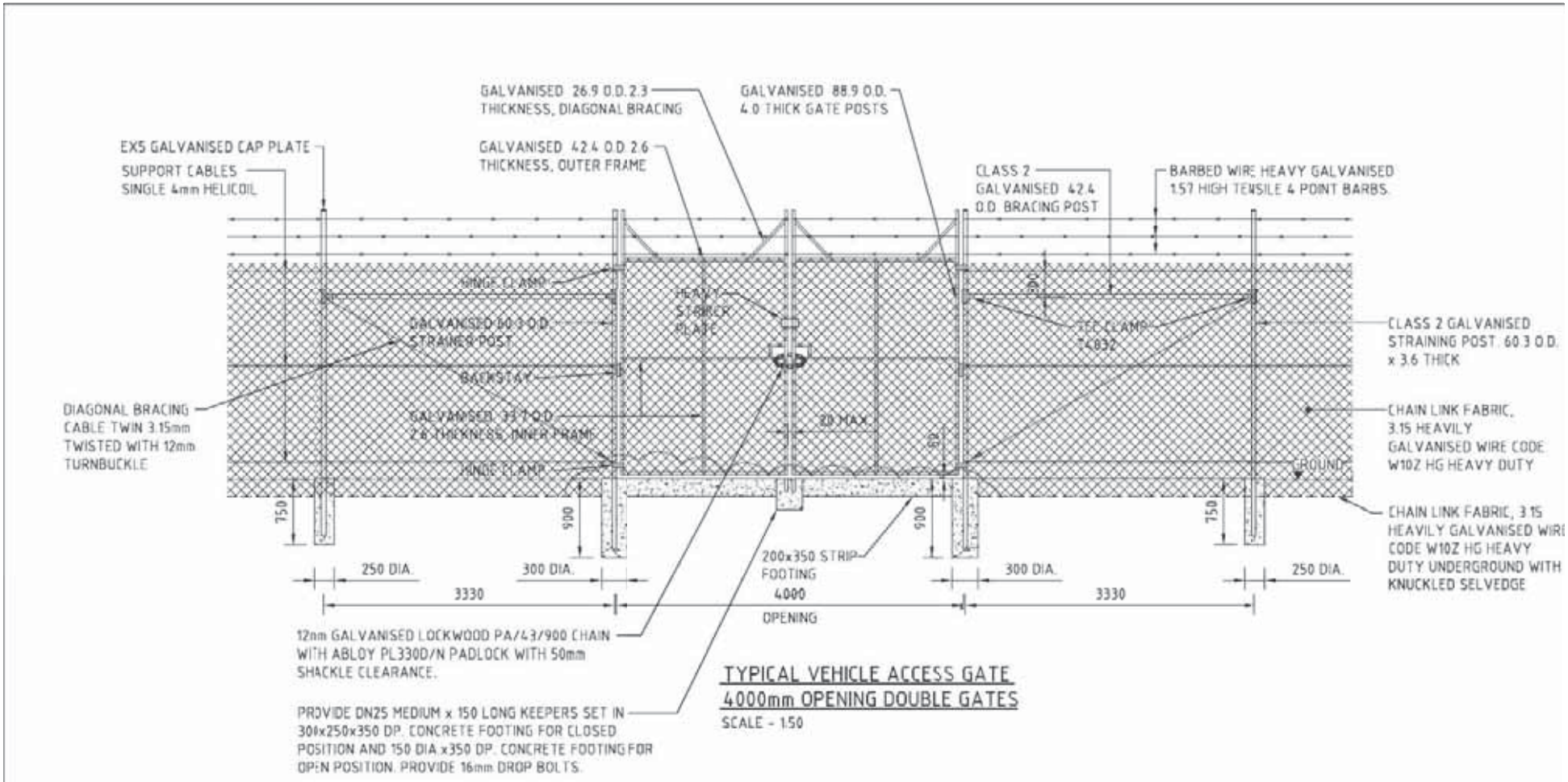
SCALE 50

REV. A1

CAD FILE GULLEN-G-GEN-0X

SHEET SIZE A3

DWG No. GULL-S-GEN-05




## TYPICAL VEHICLE ACCESS GATE
## 4000mm OPENING DOUBLE GATES

SCALE - 1:50

| REV. | DATE | DESCRIPTION | DRWN. | CHKD. | APPR. |
|---|---|---|---|---|---|
| A1 | 11.05.16 | ISSUED FOR REVIEW | DW | | |

Balance UTILITY SOLUTIONS

THIRD ANGLE PROJECTION



TITLE

GULLEN PV ARRAY
PERIMITER FENCE
GATE DETAILS

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN mm

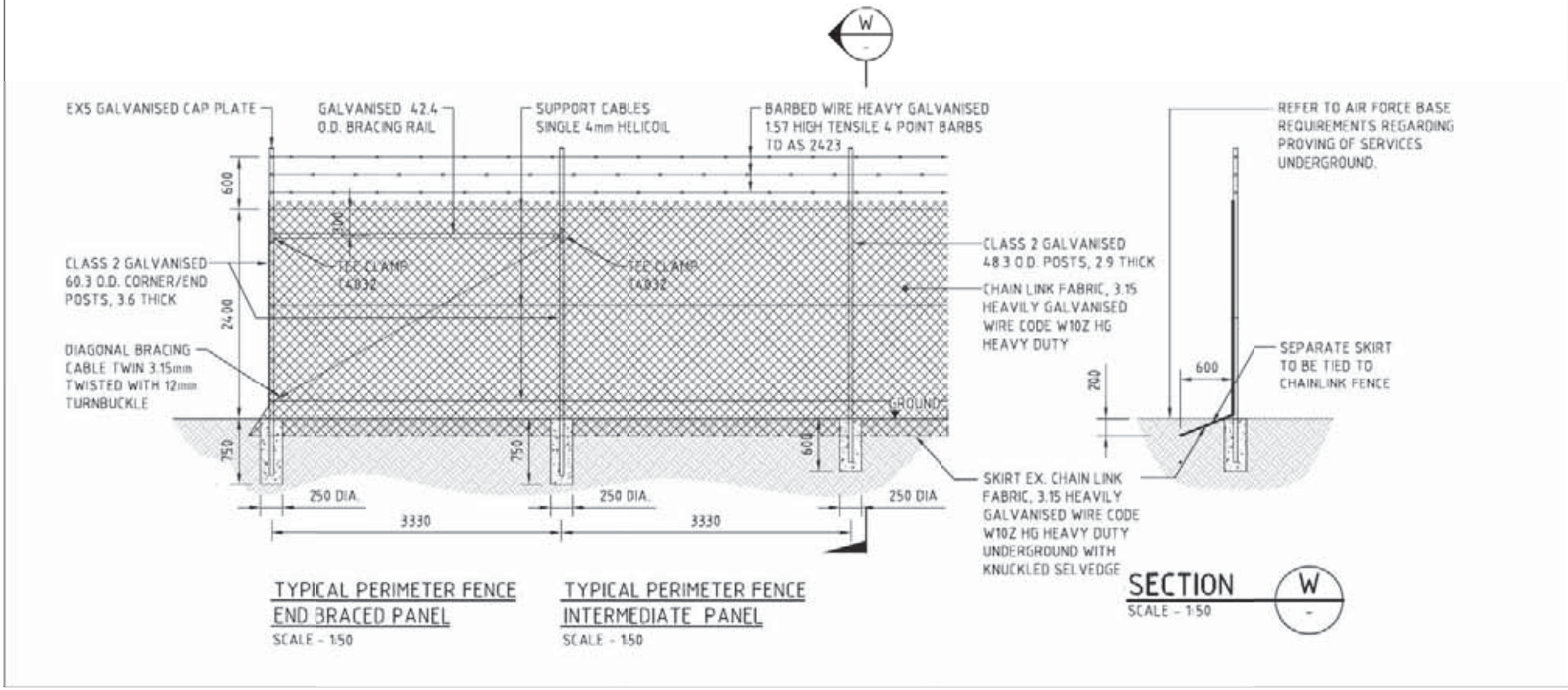
SCALE 1:50

REV. A1

CAD FILE GULLEN-fENCE

DWG No. GULL-S-DET-05

SHEET SIZE A3




| REV. | DATE | DESCRIPTION | DRWN. | CHKD. | APPR. |
|---|---|---|---|---|---|
| A1 | 11.05.16 | ISSUED FOR REVIEW | DW | | |

Balance UTILITY SOLUTIONS

THIRD ANGLE PROJECTION



TITLE

# GULLEN PV ARRAY PERIMITER FENCE FENCE DETAILS

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN mm

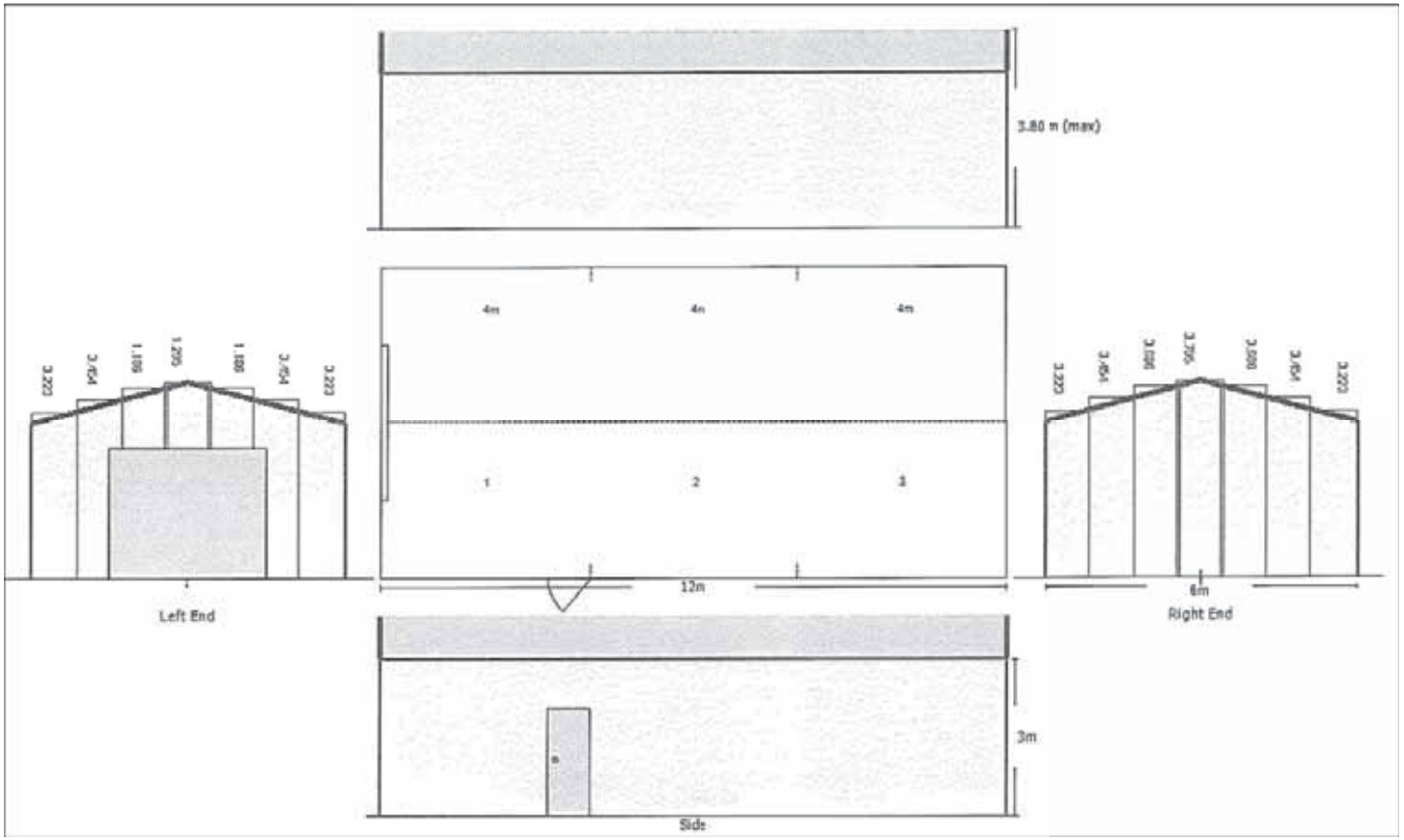
SCALE 1:50

REV. A1

CAD FILE GULLEN-FENCE

SHEET SIZE A3

DWG No. GULL-S-DET-06




| REV. | DATE | DESCRIPTION | DRWN. | CHKD. | APPR. |
|---|---|---|---|---|---|
| A1 | 11.05.16 | ISSUED FOR REVIEW | DW | | |

THIRD ANGLE PROJECTION



TITLE

# GULLEN PV ARRAY
# STORAGE SHED
# SHED OUTLINE

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN mm

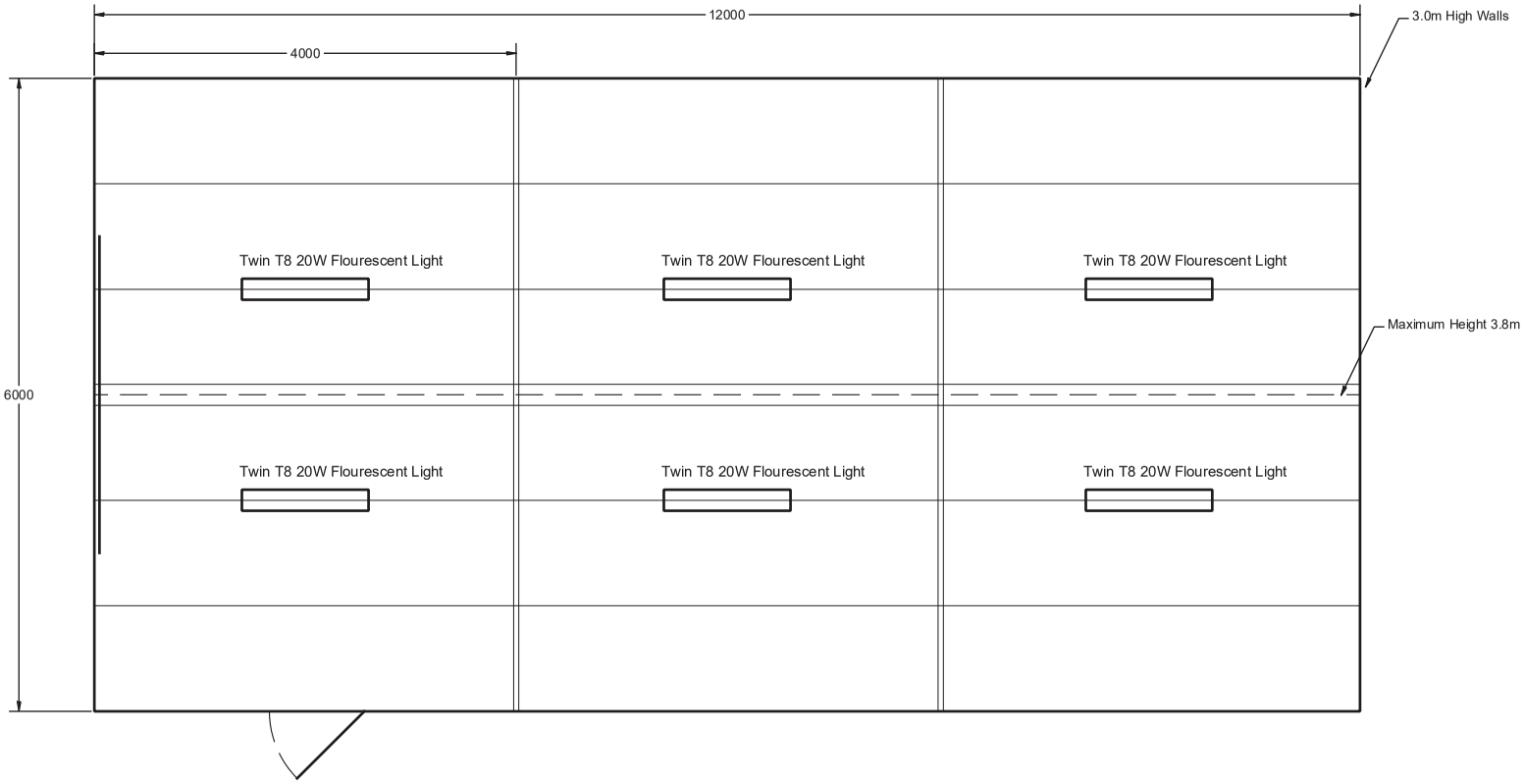
SCALE 1:100

REV. A1

CAD FILE GULLEN-SHED

SHEET SIZE A3

DWG No. GULL-S-DET-01




| REV. | DATE | DESCRIPTION | DRWN. | CHKD. | APPR. |
|---|---|---|---|---|---|
| A1 | 11.05.16 | ISSUED FOR REVIEW | DW | | |

THIRD ANGLE PROJECTION



TITLE

# GULLEN PV ARRAY
# STORAGE SHED
# SHED LIGHTING

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN mm

SCALE nts

REV. A1

CAD FILE GULLEN-E-DET-01

SHEET SIZE A3

DWG No. GULL-E-DET-01

# Proposed Gullen Solar Farm, Southern Tablelands NSW NorBE Assessment

## Report Prepared for: Goldwind Australia Pty Ltd

February, 2016
Project No. 016-089

Prepared by:
Sustainability Workshop Ltd

Head Office
4 Park Avenue
Blackheath
NSW 2785
mark@sustainabilityworkshop.co
T +61 2 47878428
www.sustainabilityworkshop.com

# Document Information

| | | |
|---|---|---|
| Project title | Solar Farm at Bannister by Goldwind Australia – NorBE Assessment | |
| Document title | As above | Project number 016-089 |
| Description | | |
| Client Contact | Trent La Franchi | |

| | Name | Signature | Issue: | Date |
|---|---|---|---|---|
| Prepared by | Mark Liebman |  | B | 26/2/16 |
| Checked by | | | | |
| Issued by | | | | |
| Filename | | | | |

## Document History

| | Issue A | | Issue B | | Issue C | |
|---|---|---|---|---|---|---|
| Issue to: | Date | No. Copies | Date | No. Copies | Date | No. Copies |
| Trent La Franchi | 25/2/16 | PDF & Word | 26/2/16 | PDF & Word | 12/05/2016 | PDf & Word |
| Brooke Marshall | 25/2/16 | PDF & Word | 26/2/16 | PDF & Word | | |

## Commercial in Confidence



## Disclaimer

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## Attachments:


A - Water NSW Correspondence, February 2016

B - Water NSW submission to Upper Lachlan Shire Council on 18th March 2016

C - Revised layout that has been submitted for planning purposes.

# 1.0 INTRODUCTION

## 1.1. Background and Context

The Sustainability Workshop (TSW) was commissioned by NGH Associates on behalf of Goldwind Australia Pty Ltd to assist with the assessment of a proposed solar farm in the Southern Tablelands of New South Wales, approximately 12km south of Crookwell and 28km northwest of Goulburn. The proposed 101 MW solar farm is adjacent to the existing Gullen Range Wind Farm.

The proposed solar farm is located within the Sydney Water Drinking Water Catchment and is therefore subject to the Sydney Drinking Water State Environmental Planning Policy (SEPP). This SEPP is administered by Water NSW (WNSW) formerly the Sydney Catchment Authority (SCA).

This report assesses if the proposed development will have a neutral or beneficial effect on drinking water quality as required by the SEPP.

A DA for the proposed development has been lodged with Upper Lachlan Shire Council – DA 7/2016 Storriers Lane, Bannister. The DA was referred to Water NSW for their concurrent assessment. Mark Liebman from the Sustainability Workshop, Trent La Franchi from Goldwind and James Caddey from Water NSW met at the proposed solar farm site to review the proposed development and scope for relevant issues.

A letter was subsequently prepared by Water NSW, dated 22/2/2016 (Attachment A), which listed their concerns. This report addresses the issues raised by Water NSW.

In response to the original planning submission, a response was prepared by Water NSW, dated 18/3/2016 (Attachment B), which outlined their advice for the project. This report aims to further address the issues raised by Water NSW.

## 1.2. Site Location

The land is located at Storriers Lane, Bannister near Crookwell and west of Goulburn. Refer to Figure 1-1 (image courtesy NGH Associates).

The site is elevated at about 860m above sea level and on the very edge of the drinking water catchments. If the proposed development was located a little further west it would drain into the Lachlan River catchment.

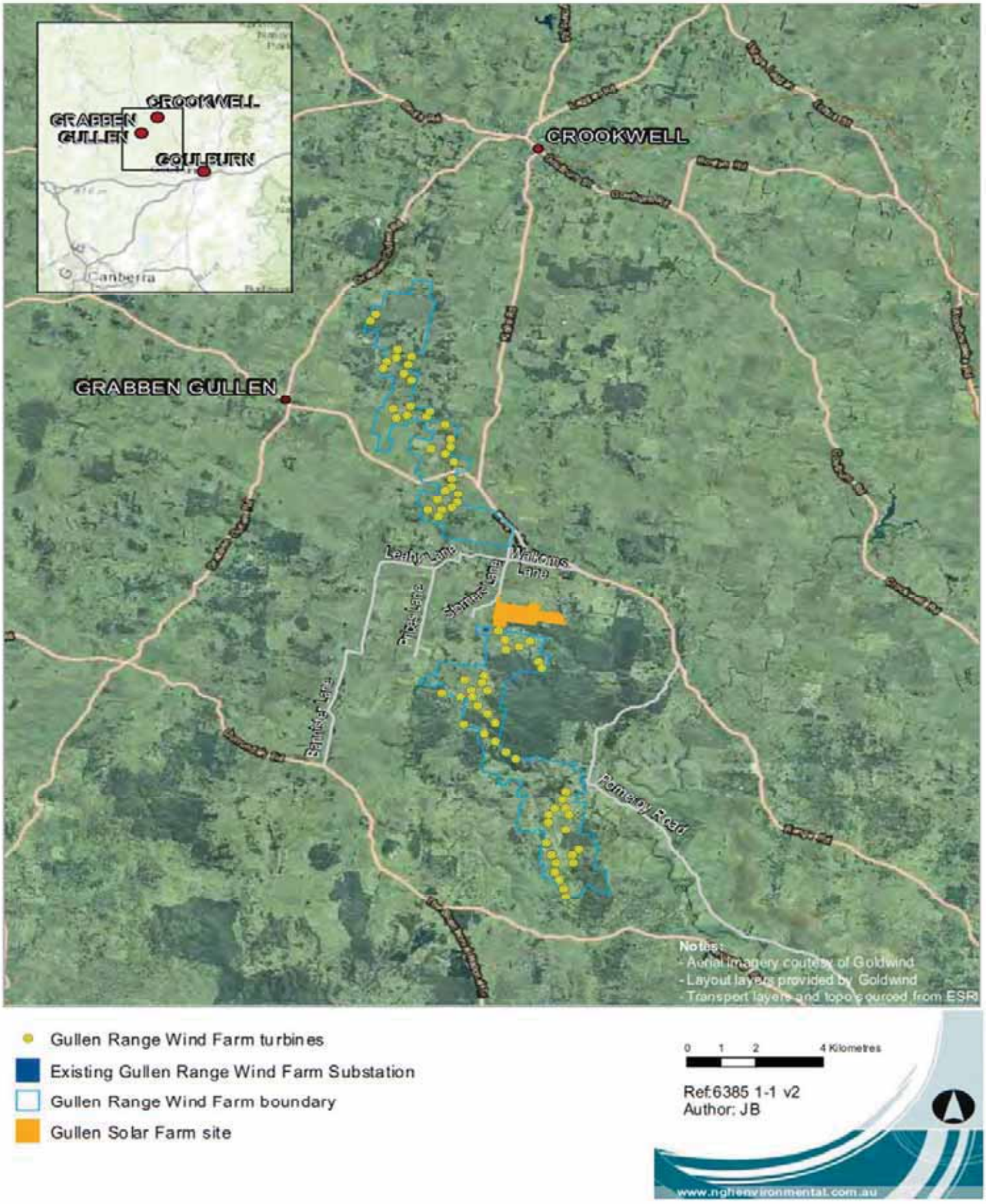



Figure 1-1 Regional location of the proposal.

## 1.3. Site Description Including Soils

The majority of the proposed development is to be located on north facing slopes which have grades varying between 3% and about 10%. A proportion of the development is to be located on slopes facing east with the same gradients. Upper slopes are steeper and lower slopes shallower.

The site is currently well covered with grass and has four distinct rows of pines, planted on a north south axis, presumably to act as a wind break during (cold) winter months when westerly winds prevail. These are clearly visible in Plate 1 below.


Plate 1 Aerial view of the proposed development (2016) (approximate site boundary shown in red)

Analysis of aerial photography from 2010 to 2016 using Google Earth Pro indicates very little discernible change on the site. The minor relocation of one of the vehicular tracks on the site and construction of a small new dam adjacent to the track has occurred prior to 2010.

Plate 2 below shows the site in 2010. Note the extents of the gully erosion hasn't changed between 2010 and the present day.


Plate 2 Aerial view of the site in 2010 (courtesy Google Earth Pro)

It was advised by Water NSW that they have funded waterway stabilisation and erosion control works on the site in the past and presumably the Soil Conservation Service has funded the planting of the rows of pines many years ago though the date or reason for planting is unknown.

### 1.3.1. Soils

The site has two very distinct soil groups. A westerly soil group which has a moderate erosion potential (mapped by SCA as the Midgee soil group) and an eastern soil group (mapped by SCA in 2002 as Blakney Creek soil group), which has a high potential for erosion. It is suggested that the westerly soil group is located on slopes facing north and where there is a change of aspect the soil group is likely to change to the more erosive soil group. The colour of water in the dams located in the creek that traverses the site is also a good indicator of where the soils change.

The Blakney Creek soil group poses a higher risk of erosion and will be harder to revegetate given its low fertility. Field notes from the soil investigation indicate it is a “Crappy” Ordovician Lithosol.


Plate 3 showing the site with three easterly dams with clear water and the westerly dam with colloidal water (image courtesy Google Earth Pro)

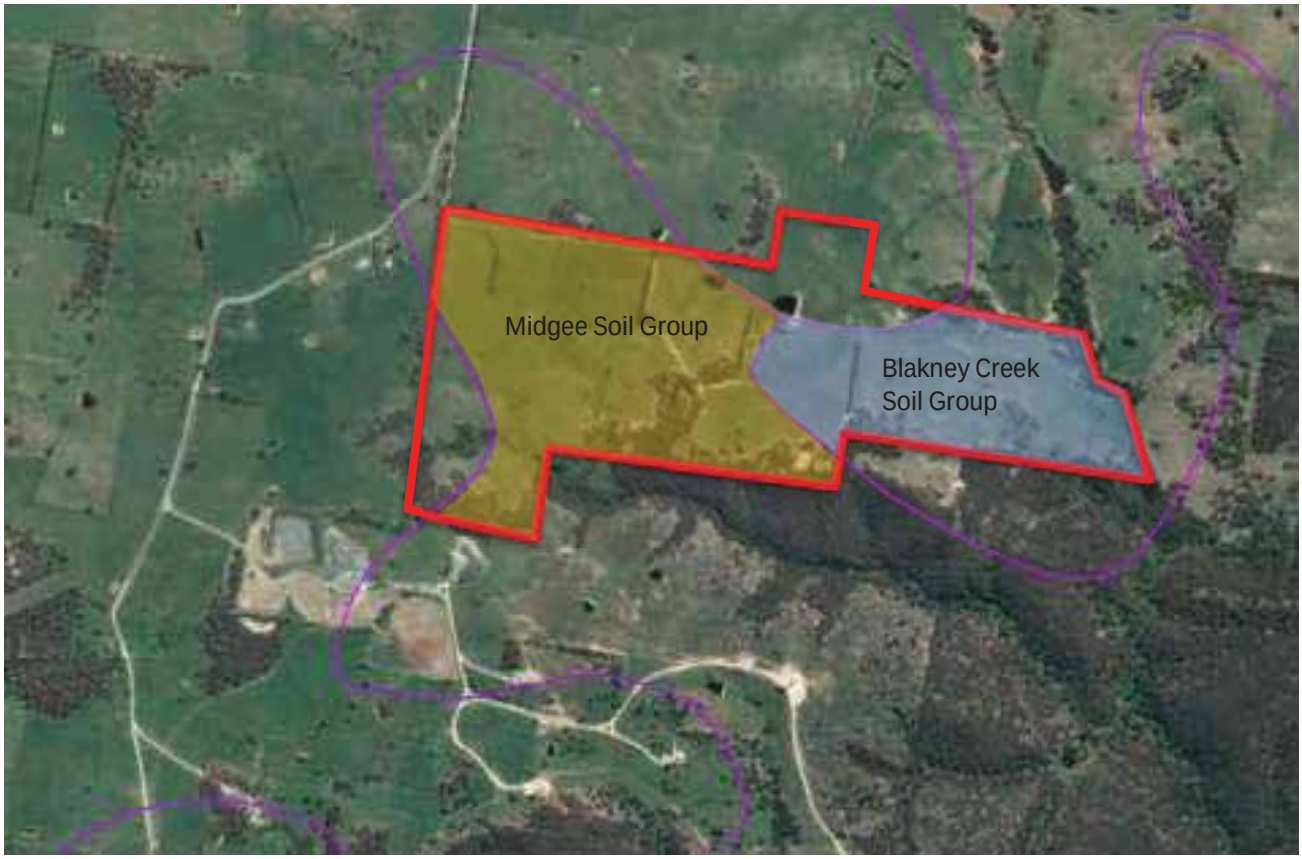


Plate 4 showing the soil mapping by SCA.

The boundaries of the soil map are approximate only and should be guided by observations during construction to establish the correct location.

## 1.4. Site Investigation

The site was investigated and issues scoped jointly with James Caddey from WNSW and Trent La Franchi from Goldwind Australia on the 19th of February, 2016.

Key points/issues learned from the site visit:

1) The whole site is generally well covered with grass or trees however there are some small patches where soils are exposed though they appear to be reasonably stable, i.e. there was no evidence of very active erosion – i.e. sediment transported downstream of bare patches.
2) The panel orientation will be at about 20 degrees sloping to the north and each panel will be 2m by 1m with an aerial footprint of about 1.5m by 1m. It was observed that panels which are located on north facing slopes would be oriented parallel with the contours and so runoff would not become concentrated and which would therefore pose a reduced risk of erosion.
3) Panels which are located on east facing slopes where the panels are oriented perpendicular to the contours would result in the development of concentrated flow and pose a higher risk of erosion.
4) The majority of the proposed solar farm will be sited on the Midgee soil group which slopes to the north with a lower risk of erosion while about one third of the proposed panels would be located on the Blakney Creek soil group which slopes to the east with a higher risk of erosion.
5) There has been gully erosion on the first order creek located in the north of the site. The erosion has largely been arrested and substantial regrowth is occurring in the gully. The age of some trees in the gully indicate the gully had been eroding for decades and was probably the result of previous poor farming practices. The gully has now been fenced to keep stock out though there is a gap in the fence at one location where a gate has not been constructed.
6) Some of the site soils have very low fertility and almost no topsoil evident. This will make revegetation of these areas more difficult and soil ameliorants, composts or fertilisers may be required to stimulate rapid regrowth of grass in disturbed areas.
7) The existing access track shows little sign of erosion but has turnouts (small contour drains) where the grades are steeper. These are working well to prevent erosion.
8) The existing house on the site has an approved wastewater treatment system with a capacity of 400 L/day confirmed by WNSW in its letter dated 22/2/2016.

9) The proposed routes of the high voltage cable connection to the wind farm substation traverse some steep to very steep and erodible country and care will need to be taken during construction and with on-going management. Construction of this cable route should be undertaken in accordance with Water NSW current recommended practices (CRPs) – Managing Urban Stormwater: Soils and Construction Volume 2A – Installation of Services. Refer to Section 3 which details all the CRPs.

# 2.0 DESCRIPTION OF PROPOSED DEVELOPMENT

A revised and abbreviated description of the proposed developed is included below. This description is focussed on potential water quality impacts and aimed at clarifying matters for WNSW.

## 2.1.1. Panel details and plans

A typical panel separation detail and panel plan is shown below (courtesy Trent La Franchi from Goldwind).

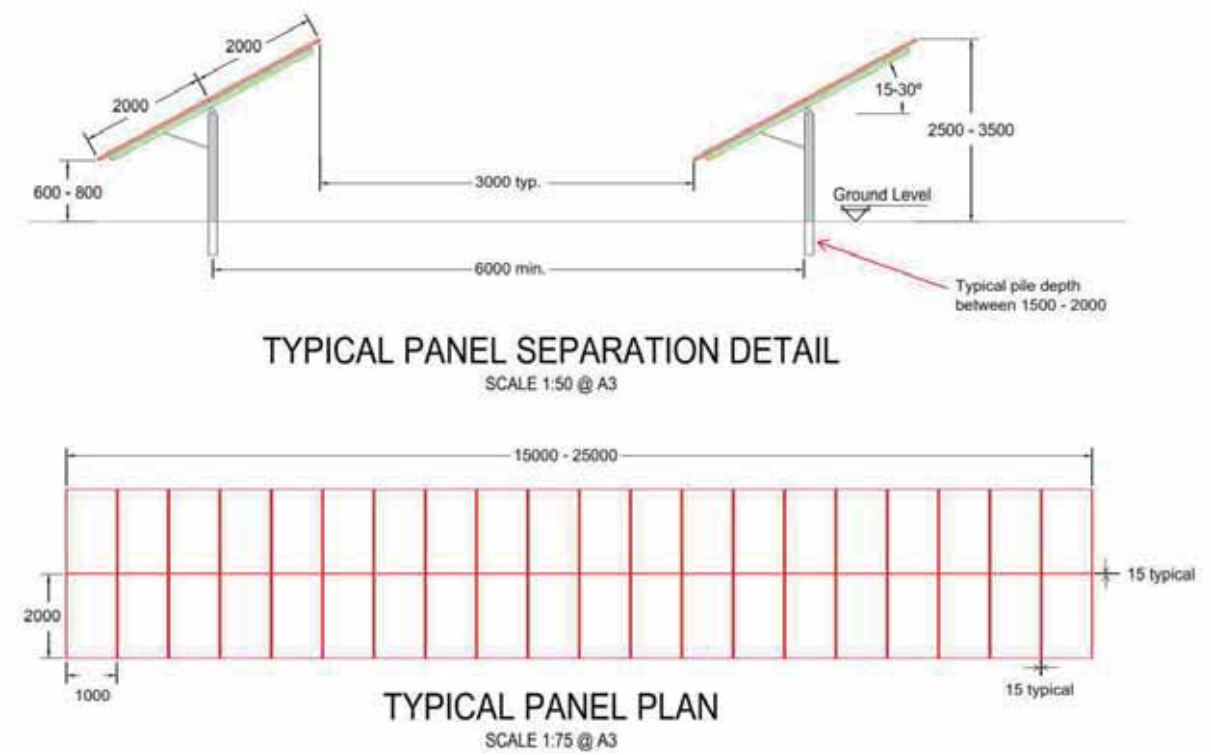



Figure 2 Typical Panel Separation Detail and Plan

Figure 2 shows the panels form indirectly connected impervious areas with a gap of 3m between rows of panels.

Within each row of panels, there is a 15mm gap between all panels to allow the upper panel to drain or drip onto the ground mid-way down the panel.

The aerial footprint of each 2m X 1m panel is 1.5m X 1m due to the proposed slope.

### 2.1.1. MUSIC modelling and Indirectly Connected Impervious Area Generation

Approximately 38,000 panels in total are proposed with an approximate combined indirectly connected impervious area of (38,000 X 1.5) 57,000 $m^2$ or 5.7 hectares. This would occur within an area indicated as the 'array envelope' of approximately 19.4 hectares.

It is critical to note that the panels would form indirectly connected impervious areas. Indirectly connected impervious areas behave very differently to directly connected impervious areas. In this case water can flow freely over the land surface beneath the panels and so once water is shed from the panel some of the panel runoff would infiltrate, some would evaporate, some would be lost through evapotranspiration and some would runoff. Due to the multiple processes that occur on pervious areas the water that would runoff from the ground surface would not have the same water chemistry as the water that was originally shed from the panels.

MUSIC and industry approaches consider this issue carefully and requires only directly connected impervious areas be modelled. To clarify this point, if the array was to be modelled in MUSIC, the array would not be modelled as an impervious area – it would be correctly modelled as a pervious rural land use with very little difference then between the pre and post development MUSIC models.

The above statement in no way diminishes the potential erosion risk caused by the panels but it justifies not undertaking water chemistry modelling for this proposed development.

In addition to the panels, the proposed development will include ancillary structures:

- 0.62 Hectares of access tracks which will be constructed from gravel
- Fence posts of negligible area
- Inverters of negligible area
- Sheds of negligible area
- CCTV Poles
- General infrastructure of 0.7 Ha.
- Temporary construction pad of 1 hectare on which to store materials and plant and equipment. As much of the temporary pad will remain grassed as possible while trafficked areas will be gravel sealed. The working area will have localised sediment and erosion controls measures installed around its perimeter.

It is noted that the areas cited above are based on the latest design drawings and are a more accurate reflection of actual impact areas than the estimates presented in the EIS.

### 2.1.2. Tree Removal

In addition to panel construction it is necessary to remove ~~three~~ two rows of the existing pine wind breaks due primarily to the shading they will cause resulting in a reduced performance and yield from the solar farm.

The ecological value of the trees has been assessed by NGH Associates as low and the trees can be removed. WNSW has identified that the trees were funded as part of soil conservation works probably as wind breaks and much less likely for the reason of combating salinity given their north-south orientation down the slope not across it.

It is suggested here that the trees may have been planted at a point in time when the site was largely exposed with poor grass cover due to overstocking. The trees may also have been planted simply to build a windbreak to prevent a perceived problem from occurring. The reason for planting is unknown.

Assuming the trees were planted to prevent top soils from being subject to wind erosion, it may well have been that the site would not seal without the windbreaks in place. Since then the site has sealed and is now well covered with grass and no longer subject to wind erosion. Therefore, it is considered that the trees have served their purpose and are no longer required. It is not considered necessary to duplicate/replace the trees from a soil erosion or water quality perspective.

### 2.1.3. Cable Connection and Access Track to the Substation

A high voltage cable is proposed to connect the farm to the existing substation at the wind farm. The EIS submission includes an access option that follows this cable route. Since the submission of the EIS, it has been confirmed that the access track will not follow the cable route to the existing substation and this option has been removed from the proposed development. Existing access will be utilised via Storriers Lane between the proposed solar farm site and the existing Gullen Range Wind Farm substation.

### 2.1.4. Wastewater Disposal

The proposed development will include the use of:

1) The existing on-site treatment facility which has a capacity of up to 400 l/d. Currently there is one outside toilet on the site. Assuming staff don't shower on-site, the toilet would enable up to 40 staff to use it during construction. However because use would most likely be limited to scheduled work breaks, it is likely that several toilets would be required at the same time.
2) Therefore, portable toilet blocks, Portaloos or similar pump out toilets will be used to make up any shortfall in the minimum number of toilets required to service the workforce present on the site, while satisfying all relevant WH&S and Workcover NSW requirements. This will be managed by the contractor during the construction period as staff levels vary onsite.

# 3.0 EROSION CONTROL

## 3.1. Current Recommended Practices

The development on the site will need to comply with WNSW's current recommended practices (CRPs). The CRPs have legal standing under the SEPP and WNSW can enforce compliance under the SEPP.

The relevant CRPS can be downloaded from the Water NSW website at:
http://www.waternsw.com.au/about/pubs/crp

The following CRPs must be complied with:

1) Rural Earthmoving in the Sydney Drinking Water Catchment (SCA, 2014).
2) Managing urban Stormwater: Soils and Construction Vol. 1, 4th edition (Blue Book, Volume 1).

   Compliance with the Blue Book can be used as mitigation in the event that pollution occurs. A failure to comply with the Blue Book can result in a breach of the Protection of the Environment Operations Act. The maximum permissible discharge concentration of total suspended solids from a construction site is 50 mg/L.
3) Managing urban Stormwater Soils and Construction – Vol 2A Installation of Services. This CRP will cover the installation of the high voltage cable and all services trenches that form part of the development proposal.
4) Managing urban Stormwater Soils and Construction – Vol 2C Unsealed Roads

   This CRP covers the access track installation.
5) Guideline for the Preparation of Environmental Management Plans (2004).

   This CRP guides the preparation of operational environmental management plan which will need to be developed to ensure that on-going management of the site includes measures to maintain groundcover and prevent erosion.

The construction of north aligned solar panels poses a low risk of erosion across most of the site and in most cases an adaptive management approach is reasonable to adopt. That is an approach which seeks to manage an erosion problem if it arises.

However where the land slopes to the north-east or east it is likely that concentrated flows will develop due to the northerly orientation of the panels.

The higher risk area has been mapped and is shown below in Figure 3.

## 3.1.1. Areas of High Erosion Risk

This section discusses the areas of high erosion risk that have been identified on the site during the February site visit. These areas highlighted in the below image (Figure 3).

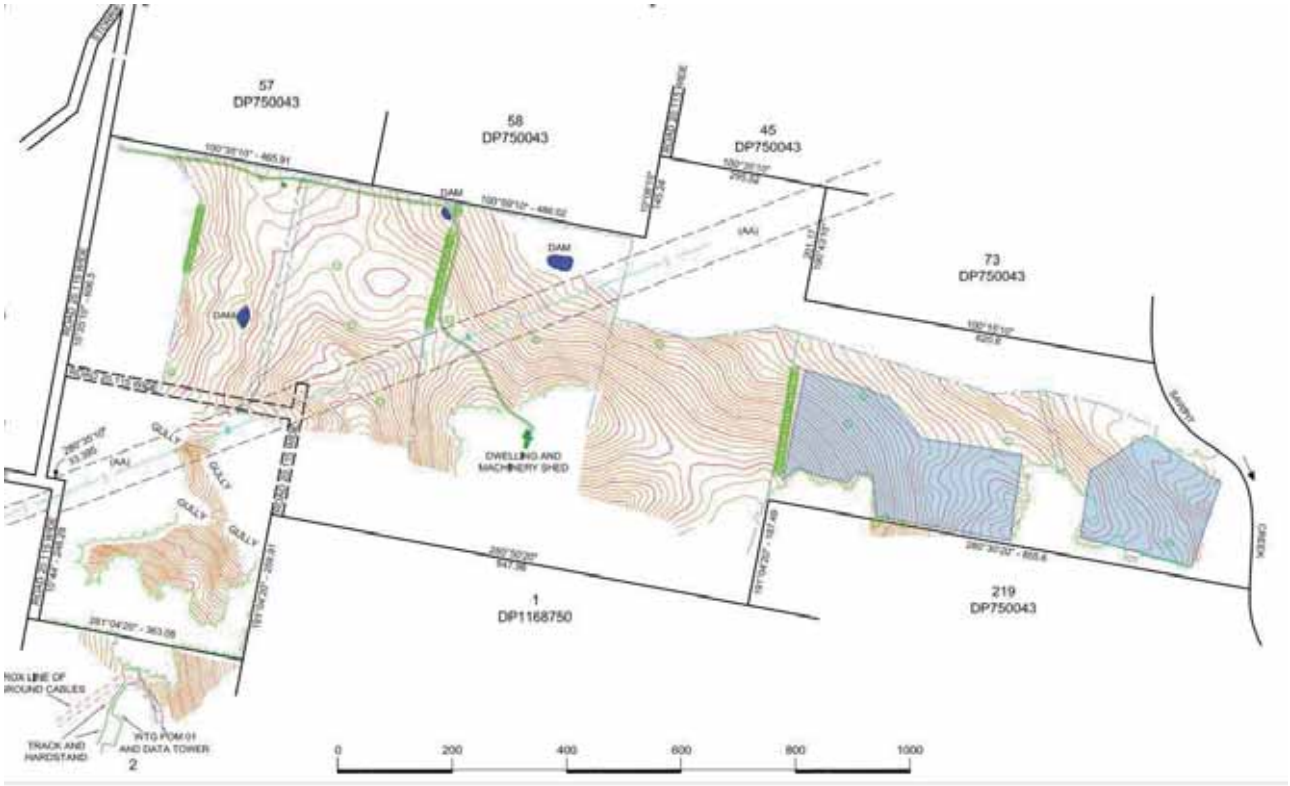



Figure 3 Showing the area prone to a higher risk of erosion shaded blue

The following management measures are recommended for panels located in this high risk area:

1) Swales to limit overland flows
   In the areas of high erosion risk where the land falls to the east or is located on steeper slopes (approaching 10% or more) sloping to the north east, between panel rows, approximately every 25m to 50m, construct a shallow swale (nominally 100mm deep, 350mm wide base and 1 in 4 side slopes) to convert concentrated flows into dispersed or sheet flow. In effect these are mini level spreaders and would restore a sheet flow regime across the area reducing erosive velocities associated with concentrated flow.

   Where the separation between swales is 50m (due to conflicts with power cables or similar) an adaptive management plan shall be prepared to monitor for erosion and if required to retrospectively construct swales at a 25m spacing. This commitment shall be included in the OEMP.

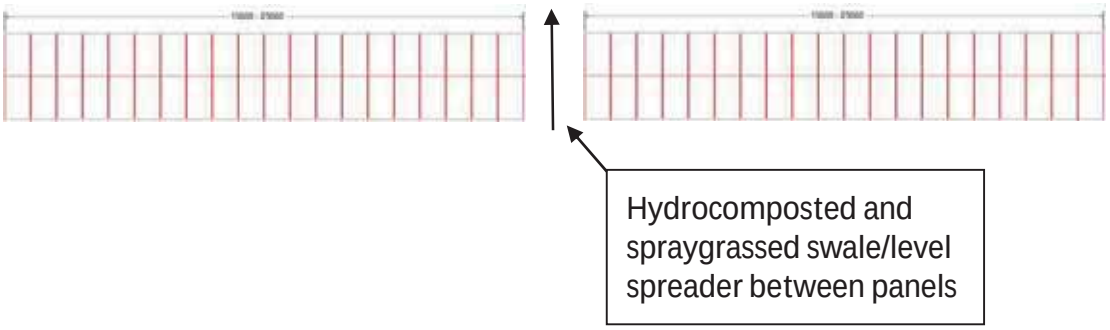
   Note the importance that the downstream top of batter must be parallel (i.e. flat) to the contour to ensure that the swale fills and overflows evenly to achieve sheet flow.

It is recommended that a combination of hydrocompost and spraygrass (or equivalent product) be used to rapidly revegetate the swales/spreaders. Refer to www.spraygrass.com.au for further information and an example product.

The hydrocompost will need to be designed for the site soils following a soil test with advice from the laboratory on what would be needed to ameliorate the soil, release fertility and sustain good grass growth.

It is recommended that a cool season, drought and shade tolerant grass (a buffaloe grass if possible but subject to discussion with the landowner and the spraygrass supplier) be used. It is likely that lime would need to be added as a soil improver to raise the pH and release fertility. Addition of other minerals, perhaps calcium and NPK may be required.

An indicative sketch of the proposed swale panel arrangement is shown below in Figure 4.




A typical swale cross section is shown below:

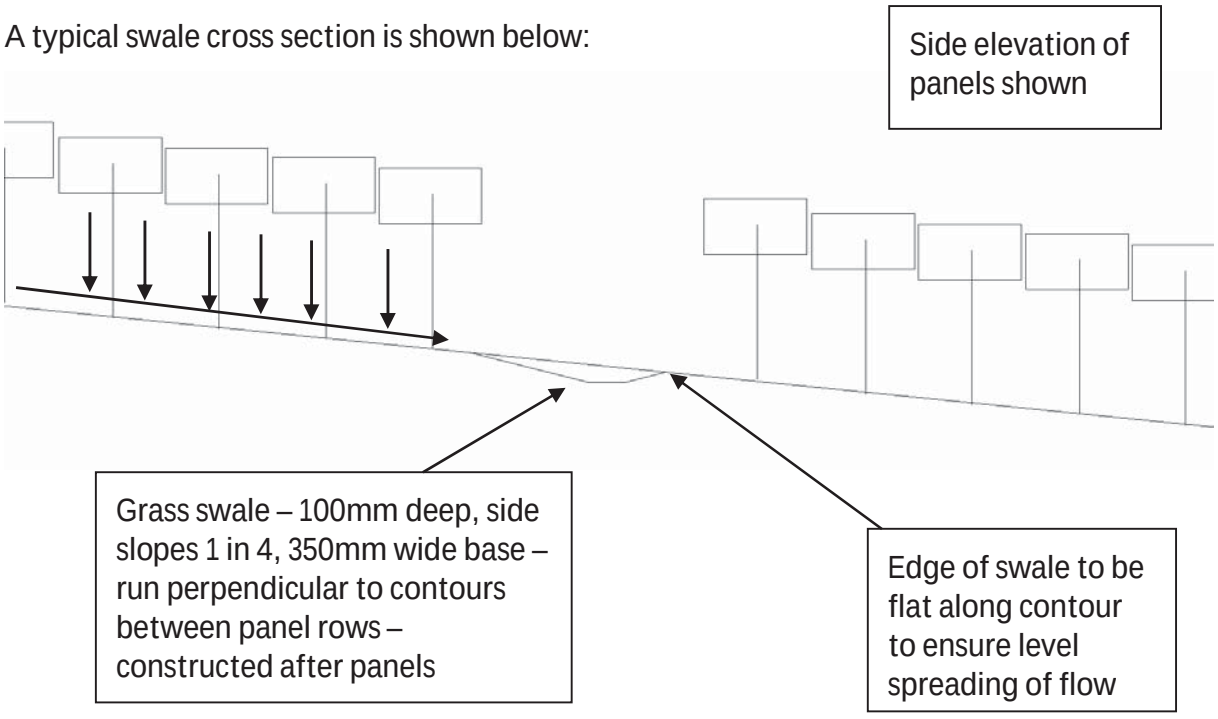



Figure 4 Proposed Swale Plan and Elevation

2) Drip Line Protection

In the areas of high erosion risk, it is suggested to protect the soil in the long term under the drip line of the panel, use the same combination of hydrocompost and spraygrass (or equivalent product) to reinforce an area 500mm each side (that is 1m wide) of the drip line of panels located in the higher risk area. It is crudely estimated than area of up to approximately 7,000 $m^2$ will require treatment.

This measure is required to ensure that there is no erosion along the drip line where concentrated flows will occur. By improving the soil fertility with compost and spraying grass on the drip line this will allow good grass growth to resist erosion.

The grass will be well watered due to the runoff from the panels and will likely provide excellent grazing for livestock.

3) Consideration of bitumen and jute matting

In the assessment of the site, the potential for utilising bitumen and jute matting has been discussed particularly with regards to the drip line protection. It is considered that this is not the most suitable method for use at this site due to the following reasons:

- Poor soil fertility: The soil at the site is predominately of a very poor soil fertility, whereas it is understood that bitumen and jute matting will not improve the long term fertility of the site soils and so once depleted will need to replaced. The spraygrass and hydromulch approach suggested above in line 2) is deemed to be more suitable for use at the site due to its ability to improve soil fertility and provide a longer term, lower maintenance solution. It is acknowledged that spraygrass and hydromulch is prone to washaway however this should be managed within the maintenance program of the site. Should wash away occur the spraygrass and hydromulch will be promptly replaced and until such time as it has effectively established.
- Greater environmental impact: One of the key objectives of the solar farm project is to delivery a sustainable project which creates minimal environmental impact in its construction and operation. By the installation of tars and matting, it will increase the project's environmental footprint which conflicts with the project's sustainability goals.

### 3.1.2. Areas of Low Erosion Risk

The majority of the site has been identified as low erosion risk. It is proposed to take an adaptive management approach to these areas as outlined below in Section 3.2 of this report.

## 3.2. OEMP Commitments

Apart from specific management of erosion in higher risk areas an adaptive management approach is recommended for this site. The followings must be included in an EMP or OEMP which covers the site and which will be prepared in accordance with the CRPs:

- Management of any erosion from areas of land where no construction phase mitigation measures are put in place. Greater vigilance is required on steeper slopes. If erosion does occur then it is recommended that swales/spreaders are put in place to reduce velocities and arrest the erosion. Eroded patches will need to be revegetated.
- Site inspection after major weather events
- Monitoring and if required retrospective construction of grassed swales/level spreaders at a greater frequency than adopted.
- The swales will need to be maintained to ensure they do not lose capacity. If erosion does occur they may fill with silt and this should be raked out of the swale to restore capacity.
- Monitoring of the eroded gully and any riparian revegetation works carried out on Waterfront land under a Vegetation Management Plan approved by the NSW Office of Water. If the construction of the panel array results in erosion of the top bank of the gully (or any part of the gully) then it is recommended that one of two possible options be implemented.
    - Option 1 would be to construct a grassed buffer strip – minimum 2m wide alongside and adjacent to the fenced off riparian corridor. This could be done using the hydrocompost and spraygrass combination described earlier. This buffer itself would need to be fenced off from stock to allow the grass to grow to a nominal depth of 200mm where it will function effectively as a buffer. The existing fence could be moved to achieve this.
    - Option 2 would be to construct a grassed swale alongside the riparian vegetation and to vegetate this using the same hydrocompost and spraygrass approach as described earlier and to then discharge this swale into the base of the eroded gully using a rock lined chute. This option is going to be more difficult to do once riparian planting has taken place.
- A Groundcover Management Plan would be developed that would include regular monitoring of vegetation cover and composition and allow for adaptive management. The aim of the plan is to retain vegetation cover under the panels, to resist erosion and weed infestation. The plan would include as a minimum:
    - A monitoring protocol to routinely assess vegetation cover and composition to allow for adaptive management
    - Suitable grazing strategies to promote native perennial groundcover

- Measures for the establishment of a shade and drought tolerant native groundcover where necessary to address the potential for soil erosion and weed ingress. Provision for advice from an agronomist (or other suitably qualified person) in relation to preferred species/varieties, establishment methods of alternative pastures and best practice management would be included. Onsite trials would be considered if information is lacking.

# 4.0 CONCLUSIONS AND RECOMMENDATIONS

Provided that the proposed solar farm development complies with the recommendations in this report the proposed development is likely to result in a neutral or beneficial effect on water quality.

It is not appropriate to use MUSIC to model the proposed development because MUSIC requires that only directly connected impervious areas be identified as impervious area runoff. The proposed solar panels will be indirectly connected impervious areas.

The key risks to the drinking water catchments are:

1) Potential erosion
2) Wastewater management during construction. Wastewater will be managed using the existing on-site toilet and by using portable pump out toilets.

Potential erosion is to be managed as follows:

1) Construction methodology: Access tracks and services (high voltage cable construction in particular) shall comply with the relevant CRPs nominated in this document and available on the Water NSW website. Essentially this means compliance with the relevant volume of the Blue Book and the SCA document on rural earth works.
2) Operation of the Site: An adaptive management approach is to be developed and documented in an operational environmental management plan to ensure that areas of erosion are identified quickly and stabilised in a timely manner. This applies to the majority of the site located on Midgee soils and where proposed panels are oriented parallel to the contours.
3) Areas of High Erosion Risk: On the eastern part of the site underlain by more erosive Blakney Creek soil group where the slopes are east facing, two principal measures are proposed:
    1) Construct shallow swales/level spreaders at a minimum spacing between swales of 50m between rows of panels.
    2) Reinforce the surface cover with a combination of hydrocompost and spraygrass to resist the concentrated flows that would develop.
    ~~2)~~3) Maintain the swales and hydrocompost drip line protection during operation

These management measures would be included within environmental management plans to be developed for the project and within the final construction drawings, as appropriate.

Note that an adaptive approach and procedures for rectifying active erosion shall be developed for all areas of the site – especially those areas with specific erosion prevention measures. This approach fits within the Groundcover Management Plan which forms an operational commitment of the project to ensure vegetation cover under the panels is retained, to resist erosion and weed infestation.

Careful planning of the proposed cable route during the design phase of the Contract will reap benefits during construction in terms of easy management.

The Contractor shall be made aware of the very high erosion risk associated with this aspect of the project and shall be encouraged to pursue a long term, low risk route which may well have a higher capital cost because it will be a longer route with fewer waterway crossings. Goldwind should aim to achieve lower life cycle costs through lower on-going maintenance costs by pushing the Contractor to choose a route with a lower erosion risk.

The potential erosion and safety risk of the proposed access track alongside the high voltage cable is acknowledged and it is again noted that the proposed access route alongside the proposed high voltage cable is no longer part of the proposed development and has been deleted from Contract documents.

It is noted that projects like this have an invisible beneficial impact on drinking water quality through lower demand for power from coal fired power stations which both consume significant water resources but also emit polluted air which affects drinking water quality – perhaps not directly in Sydney's catchments but in adjacent catchments such as the Hunter and Macquarie catchments.

The drinking water catchments also have several active coal mines within them also which cause their own impacts such as salinity. This project will help to offset and reduce those impacts by reducing the demand for coal mined from within the catchments.

On this basis it is concluded that this project is likely to have a beneficial effect on water quality provided all CRPs and recommendations herein are adopted and implemented.

# Attachment A.

Water NSW Correspondence

PO Box 323, Penrith NSW 2751
Level 4, 2-6 Station Street
Penrith NSW 2750
1300 722 468
www.waternsw.com.au
ABN 21 147 934 787

Ref: 16035-a1
Your Ref: 7/2016

John Bell
General Manager
Upper Lachlan Shire Council
PO Box 42
GUNNING 2581

Attention: Roland Wong

Dear Sir

**Subject: Sydney Drinking Water Catchment SEPP**
**Council DA 7/2016; Lot 100 DP 1026064, Lot 2 DP 1168750, Lot 1 DP 1196222; 131 Storriers Lane, Bannister**

I refer to your letter received 11 February 2016 requesting the concurrence of Water NSW with a proposal for a solar farm on the above land as required by Clause 11 of the State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 (the SEPP).

Insufficient information has been provided with the application to enable an adequate assessment of the probable effect of the development on water quality. In accordance with the concurrence requirements of the SEPP and Clause 60 of the Environmental Planning and Assessment Regulation 2000, Water NSW requests that Council obtain from the applicant sufficient information to enable Water NSW to undertake a neutral or beneficial effect on water quality assessment (NorBE) for the development.

**Wastewater**

- The Statement of Environmental Effects indicates that the existing on-site sewage systems at the nearby wind farm will be used. There are 3 systems at the wind farm and only the temporary system that was installed for the construction phase would have adequate capacity. Please provide information indicating if the temporary on-site system is still operating and, if so, how many people are using that system and how much further capacity that system has.
- The on-site system for the building on the site is supposed to be designed for an effluent load of 400L per day

**Stormwater**

- Reasons should be given as to why a MUSIC model of the proposal is not required or not suitable
- A section showing how the panels will be supported and the separation between rows of panels, leading to an estimation of the percentage of impervious area caused by the panels with respect to the area that the panels will be occupying
- measures to be taken to ensure that the stormwater running off the panels does not cause erosion
- measures to be taken to ensure that any other works, eg access track construction and instillation of services, do not cause erosion. In this regards it is noted that

there are at least three, maybe four, drainage features to be crossed between the solar farm and the wind farm, with some showing active erosion

**Other**

- The four rows of pine trees running north south across the site were funded as soil conservation works. Given the nature of the soils these could have been either windbreaks to prevent sheet erosion or salinity prevention measures. If these trees are to be removed measures will be required to at least duplicate the effects of the trees

The "clock" will stop from the date on this letter and Water NSW will not consider whether to grant concurrence to this application until such time as satisfactory additional information is received.

If you wish to discuss this matter further please contact me on 4824 3401.

Yours sincerely

**JAMES CADDEY**
**Environmental Assessment Officer** 22/2/16

# Attachment B.

Water NSW submission to Upper Lachlan Shire Council on 18th March 2016

PO Box 323, Penrith NSW 2751
Level 4, 2-6 Station Street,
Penrith NSW 2750
Ph: 1300 722 468
www.waternsw.com.au
ABN 21 147 934 787

Ref: 16035-a1
Your Ref: 7/2016

Roland Wong
Manager Environment & Planning
Upper Lachlan Shire Council
PO Box 42
GUNNING 2581

Dear Mr Wong

**Subject: Sydney Drinking Water Catchment SEPP**
**DA No 7/2016; Lot 100 DP 1026064, Lot 2 DP 1168750, Lot 1 DP 1196222; 131 Storriers Lane, Bannister**

I refer to your letter received 4 February 2016 requesting the concurrence of Water NSW under Clause 11 of State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 (the SEPP) with a proposal for a solar farm to be connected to an existing substation.

The subject property, which has been inspected by Water NSW, is located within the Warragamba catchment which forms part of Sydney's water supply.

The following documents have been considered in the assessment of the application:

- a Statement of Environmental Effects (dated 15 January 2016) prepared by ngh environmental, and
- a NorBE Assessment prepared by Sustainability Workshop Ltd (dated 26 February 2016).

Based on Water NSW's site inspection and the information provided, the proposed development has been assessed by Water NSW as being able to achieve a neutral or beneficial effect on water quality provided appropriate conditions are included in any development consent and are subsequently implemented.

Water NSW would therefore concur with Council granting consent to the application subject to the following conditions being imposed:

**General**

1. The site layout and works shall be as specified in the Statement of Environmental Effects prepared by ngh environmental (dated 15 January 2016), but as varied by the NorBE Assessment prepared by Sustainability Workshop Ltd (dated 26 February 2016). No revised site layout, staging or external works that will impact on water quality, shall be permitted without the agreement of Water NSW.

*Reason for Condition 1 - Water NSW has based its assessment under the State Environmental Planning Policy (Sydney Drinking Water Catchment) 2011 on this version of the development.*

**Wastewater Management**

2. Portable toilet amenities shall be provided during the construction phase. The number and type to be hired shall be in accordance with the supplier's recommendation based on number of construction workers and existing site capacity. All sewage in the portable toilets shall be transported to an appropriate licenced sewerage treatment facility.

*Reason for Condition 2 - To ensure that all wastewater is collected, transported for treatment and disposal at an appropriate sewerage management facility.*

**Site Access**

3. Site access tracks shall be constructed with compacted roadbase (aggregate) as a minimum, and shall be located so as to minimise watercourse or drainage depression crossings, minimise cut and fill, minimise length, and avoid the need for vegetation clearing. The access tracks shall not exceed 10 percent slope, unless they are sealed or armoured and zigzagged up the slope. Access tracks shall also incorporate the following requirements:
    - any access track crossing of a watercourse or drainage depression shall be a properly engineered concrete causeway, pipe or box culvert crossing consistent with the guidelines Environmental Practice Manual of Rural Sealed and Unsealed Roads (ARRB Transport Research Ltd., 2002)
    - access tracks shall have vegetated swales or grassed buffer, as appropriate, on both sides of their entire length with appropriately spaced level spreaders, sills and mitre drains that divert water onto a stable surface capable of accepting concentrated water flow and provide for efficient sediment trapping and energy dissipation. Where outlets of swales discharge near drainage depressions or watercourses they shall be stabilised by an energy dissipater, and
    - all swales, buffer, batters and verges associated with the access tracks shall be vegetated and stabilised with bitumen and jute matting or similar as soon as possible after construction. In the steeper areas where the slope is in excess of 10 percent, the swales shall be armoured be armoured with boulders and cobbles.

*Reason for Condition 3 - To ensure the site access tracks and associated drainage works are appropriately managed and maintained so as to ensure an overall and sustainable neutral or beneficial impact on water quality over the longer term.*

**Stormwater and Erosion Management**

4. All stormwater management measures shall be implemented as specified in the NorBE Assessment prepared by Sustainability Workshop Ltd (dated 26 February 2016) except where varied by these conditions.
5. The drip lines for the solar panels shall be vegetated and stabilised with bitumen and jute matting or equivalent as soon as possible after erection of the solar panels.
6. The existing fencing along the drainage lines shall be retained. The vegetation in these fenced-off drainage lines be retained and weeds kept under control.
7. Livestock shall be prevented from grazing in the fenced-off drainage lines or having direct access to the creek, although water for livestock may be provided by pumps, pipes and troughs subject to any requirements of DPI Water.
8. Appropriate signage shall be provided on the fence lines along the drainage features above identifying that these fenced-off areas are for water quality management and sediment and erosion control, and are not available for livestock grazing at any time.
9. Any variation to stormwater treatment and management measures shall be agreed to by Water NSW.

10. An Operational Environmental Management Plan (OEMP) shall be prepared in consultation with Water NSW by a person with knowledge and experience in the preparation of such plans prior to the commencement of operations of the solar farm. The OEMP shall include but not be limited to:
    - details on the location, description and nature of stormwater and erosion management measures, including identification of erosive soils, measures to combat and treat erosion including vegetation, matting and any others
    - an identification of the responsibilities and detailed requirements for the inspection, monitoring and maintenance of all erosion control and stormwater management measures, including the frequency of such activities
    - the identification of the individuals or positions responsible for inspection and maintenance activities including a reporting protocol and hierarchy, and
    - checklists for recording inspections and maintenance activities.

*Reason for Conditions 4 to 10 – To ensure appropriate stormwater management and erosion control measures are implemented and maintained so as to achieve a sustainable neutral or beneficial impact on water quality, particularly during wet weather, over the longer term.*

**Construction Activities**

11. A Soil and Water Management Plan shall be prepared, in consultation with Water NSW, for all works proposed or required as part of the development by a person with knowledge and experience in the preparation of such plans. The Plan shall meet the requirements outlined in Chapter 2 of NSW Landcom's *Soils and Construction: Managing Urban Stormwater* (2004) manual - the "Blue Book" and Department of Environment & Climate Change's *Managing Urban Stormwater: Soils and Construction Volume 2A Installation of Services* (2008), Volume 2C Unsealed Roads and be to the satisfaction of Council. The Plan shall be prepared prior to issuance of a construction certificate.
12. Effective erosion and sediment controls shall be installed prior to all construction works including access, and shall prevent sediment and contaminated water leaving the construction site or entering natural or constructed drainage system. The controls shall be regularly maintained and retained until works have been completed and groundcover established or ground stabilised.

*Reason for Conditions 11 & 12 - To manage adverse environmental and water quality impacts during the construction phase of the development and to minimise the risk of erosion, sedimentation and pollution within or from the site during this construction phase.*

Under Clause 11 of the SEPP, Council must provide Water NSW with a copy of its determination of the application within 10 days of the determination.

If you wish to discuss this matter further please contact James Caddey on 4824 3401.

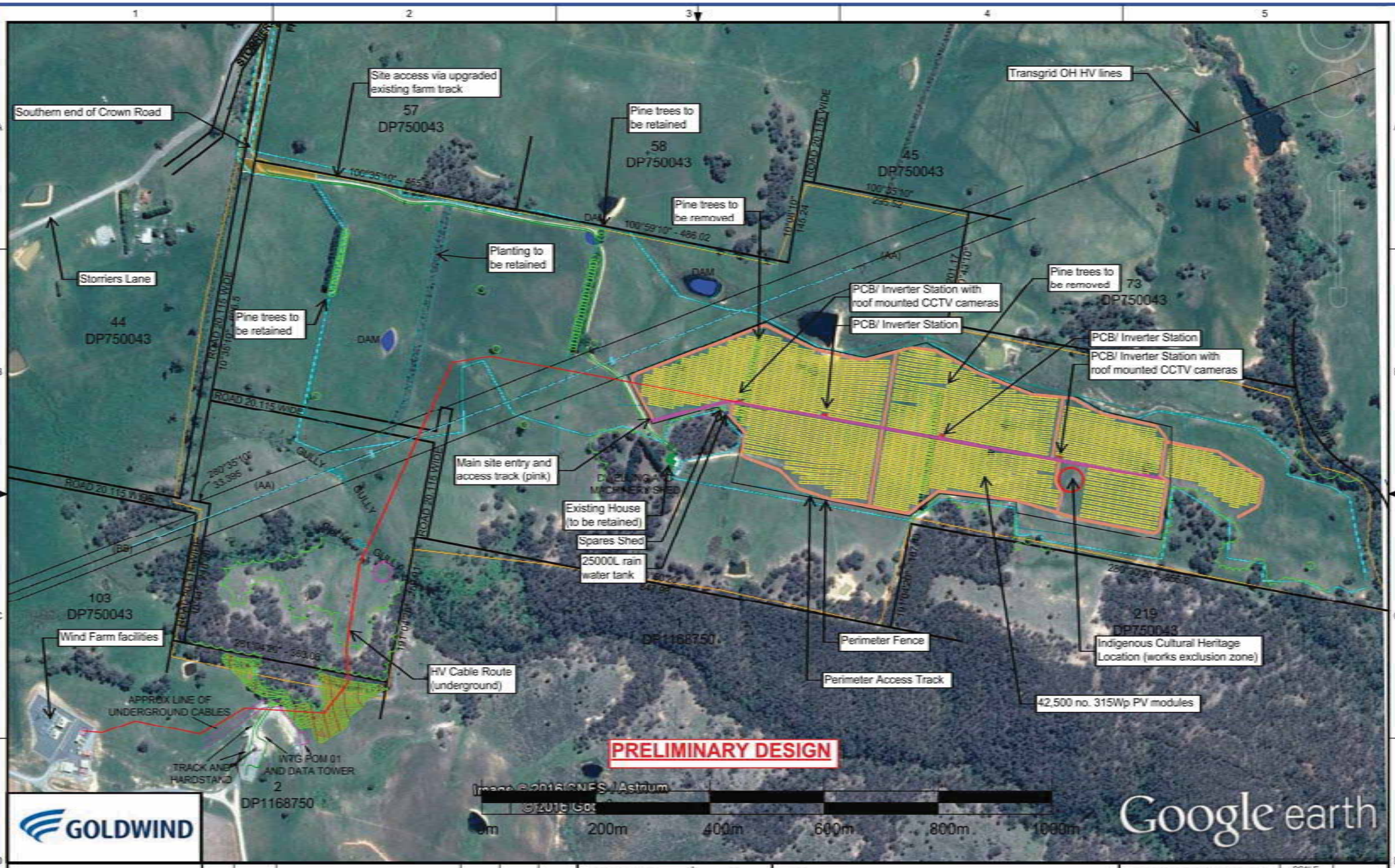
Yours sincerely

**MALCOLM HUGHES**
**Manager Environment and Planning**

18/3/16

# Attachment C.

Revised layout that has been submitted for planning purposes.




GOLDWIND

Balance UTILITY SOLUTIONS

| REV. | DATE | DESCRIPTION | DRWN. | CHKD. | APPR. |
|---|---|---|---|---|---|
| C | 16.5.16 | UPDATED FOR INFORMATION | TI F | | |
| B | 17.2.16 | ISSUED AS OPTION B LAYOUT | DW | JD | |

THIRD ANGLE PROJECTION



TITLE

GULLEN SOLAR
GENERAL ARRANGEMENT
OVERALL SITE LAYOUT

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN mm

SCALE 1

REV.

CAD FILE

SHEET SIZE

DWG No. XXXX-G-GAD-01B A3