



HASTINGS
Technology Metals Limited

APPENDIX 6-2
Noise assessment

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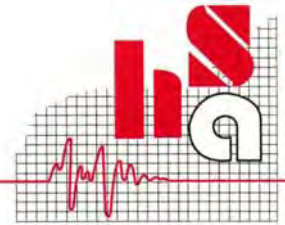
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EMISSION ASSESSMENTS FOR HASTINGS TECHNOLOGY METALS

ENVIRONMENTAL NOISE ASSESSMENT

YANGIBANA RARE EARTHS PROJECT

OCTOBER 2016

OUR REFERENCE: 21034-3-16197



DOCUMENT CONTROL PAGE

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Job No: 16197

Document Reference : 21034-3-16197

FOR

EMMISSION ASSESSMENTS

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HASTINGS TECHNOLOGY METALS

DOCUMENT INFORMATION				
Author:	Paul Drew	Checked By:	Paul Drew	
Date of Issue :	3 rd November 2016			
REVISION HISTORY				
Revision	Description	Date	Author	Checked
1	Draft	31/10/2016	PD	PD
2	Report	3/11/2016	PD	PD
3	Typographic corrections	3/11/2016	PD	PD
DOCUMENT DISTRIBUTION				
Copy No.	Version No.	Destination	Hard Copy	Electronic Copy
1	3	Emission Assessments		✓

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1. INTRODUCTION

Emission Assessments acting on behalf of Hastings Technology Metals, commissioned Herring Storer Acoustics to carry out acoustic modelling of noise emissions for proposed mining operations at Yangibana Rare Earths Project (Yangibana). The acoustic modelling is based on design data and preliminary mine-plan layouts. The operating mine scenarios may vary from those modelled, however the predicted noise emissions are expected to adequately represent the noise emissions and risk.

This report provides noise, air-blast overpressure predicted emission levels for environmental assessment. Potential sensitive receptors have been identified as the Accomodation Village (an internal receptor not subject to regulation criteria), Edmund Station (homestead) and Gifford Creek Station (homestead). The acoustic assessment includes potential noise emissions from blasting assessed as Linear Peak noise levels, and operational mining noise emissions assessed as the L_{A10} statistic for continuous noise emission in dB(A). There are other station homesteads, however these are a significant distance from the proposed operation and will not be impacted by noise emissions from the proposed operation.

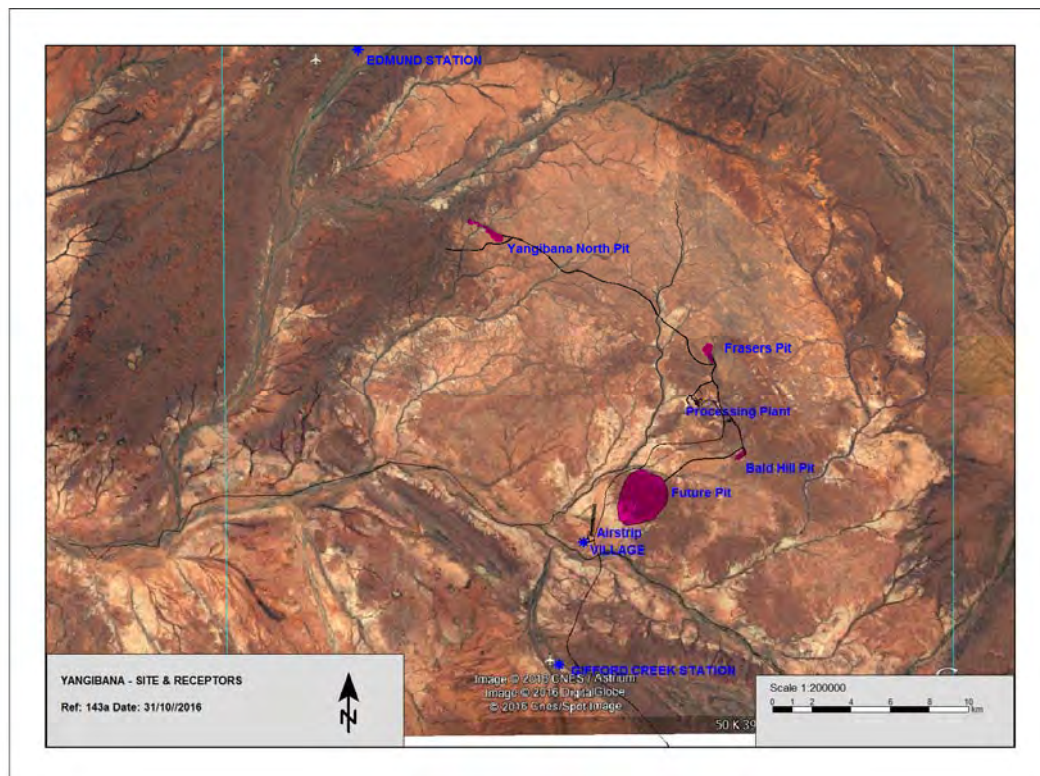


Figure 1 - Site Location and Key Receptors

2. ASSESSMENT CRITERIA

2.1 AIR-BLAST OVERPRESSURE

There are three identified sensitive receptors from air-blast overpressure noise emissions. These are the Accomodation Village (Village) and the homesteads for Edmund and Gifford Creek Stations.

The Village will be owned by the client and will be located within the mine operation premises. Noise emissions exceeding the acoustic criteria levels in the Regulations do not result in a breach of Regulations as the Village and mine are within the same premises.

Mining companies may choose to adopt their own internal acoustic criteria for airblast noise emissions based on Regulation 11 of the *Environmental Protection (Noise) Regulations 1997*. The regulation 'assigned levels' for other occupied premises would be a level of $115 \text{ dB } L_{Z \text{ peak}}$ as indicated in the extracted sections of the regulations. The requirements of Regulation 11 'Airblast levels due to blasting' are extracted from the *Environmental Protection (Noise) Regulations 1977* as follows:

- (4) *Subject to subregulation (5), no airblast level resulting from blasting on any premises or public place, when received at any other premises between 0700 hours and 1800 hours on any day, may exceed —*
 - (a) *for an airblast level received at noise sensitive premises —*
 - (i) *when received at a sensitive site — $120 \text{ dB } L_{Z \text{ peak}}$; or*
 - (ii) *when received at a location other than a sensitive site — $125 \text{ dB } L_{Z \text{ peak}}$;*

or

 - (b) *for an airblast level received at any other premises — $125 \text{ dB } L_{Z \text{ peak}}$.*
- (5) *The levels specified in subregulation (4) do not apply in respect of an airblast level when received at premises, or a part of premises, on which the blaster believes on reasonable grounds no person is present at the time of the blast.*
- (6) *Despite subregulation (4), airblast levels for 9 in any 10 consecutive blasts (regardless of the interval between each blast), when received at any other single premises between 0700 hours and 1800 hours on any day, must not exceed —*
 - (a) *for airblast levels received at noise sensitive premises —*
 - (i) *when received at a sensitive site — $115 \text{ dB } L_{Z \text{ peak}}$; or*
 - (ii) *when received at a location other than a sensitive site — $120 \text{ dB } L_{Z \text{ peak}}$;*

or

 - (b) *for airblast levels received at any other premises — $120 \text{ dB } L_{Z \text{ peak}}$.*

Effectively this means that for the majority of blasts, the air-blast overpressure level should not exceed $115 \text{ dB } L_{Z \text{ peak}}$ at the site Village if the Regulation 'assigned level' is used as an internal criteria. However this criteria is not mandatory.

The Station homesteads (if occupied) are subject to the requirements of the Environmental Protection (Noise) Regulations for blasting, as already described.

It is understood that blast times will be managed by the client and will be in the day period. If necessary the client has the option of carrying out blasting around shift changeover to minimize potential impact on personnel who might be sleeping.

2.2 CONTINUOUS MINING NOISE CRITERIA

The identified potential affected receptors from mining and processing operations are the Village and the Edmund Station and Gifford Creek Station homesteads.

The site Village is owner operated, so although some mining companies assess noise emissions to accommodation villages within their premises based on the criteria of the *Environmental Protection (Noise) Regulations 1997*, higher noise levels are not a breach of Regulations.

A commonly used criteria for background noise within buildings is Australian/New Zealand Standard 2107:2000 'Acoustics – Recommended design sound levels and reverberation times for building interiors'. This standard applies to the building unoccupied but ready for occupancy, with mechanical services systems operating (for example).

The applicable criteria for the human receptor locations under AS2107:2000 are:

TABLE 2.3.1 – AS2107:2000 RECOMMENDED DESIGN SOUND LEVELS FOR BUILDINGS

Type of Occupancy	Satisfactory L _{Aeq} dB(A)	Maximum L _{Aeq} dB(A)
Residential		
Hotels and Motels near minor road	30	<u>35</u>
Hotels and Motels near major road	<u>35</u>	40

We consider the underlined criteria as being appropriate for Yangibana.

The Environmental Protection (Noise) Regulations 1997 have an adjustment of 15 dB(A) between outside to inside (a closed window). It is reasonable to expect that the buildings would achieve this level of noise attenuation. The internal noise levels can be adjusted for the nominal building attenuation, providing an external criteria for comparison with predicted mining noise emissions. To achieve acceptable internal noise levels of 35 dB(A) for the Village the applicable criteria would therefore be a noise level of 50 dB(A) external to buildings.

For comparative purposes the criteria of the Environmental Protection (Noise) Regulations 1997 are described as follows.

The *Environmental Protection (Noise) Regulations 1997* (as amended) stipulate maximum allowable external noise levels determined by the calculation of an influencing factor. The 'influencing factor' is an adjustment in the Regulations which allows for expected higher background noise in areas affected by major roads and commercial or industrial land use nearby. The influencing factor is calculated for the usage of land within the two circles, having radii of 100m and 450m from the premises of concern.

TABLE 2.3.2 –ASSIGNED OUTDOOR NOISE LEVELS

Type of premises receiving noise	Time of day	Assigned level (dB)		
		L _{A 10}	L _{A 1}	L _{A max}
Noise sensitive premises: highly sensitive area (i.e within 15m of a dwelling)	0700 to 1900 hours Monday to Saturday	45 + IF	55 + IF	65 + IF
	0900 to 1900 hours Sunday and public holidays	40 + IF	50 + IF	65 + IF
	1900 to 2200 hours all days	40 + IF	50 + IF	55 + IF
	2200 hours on any day to 0700 hours Monday to Saturday and 0900 hours Sunday and public holidays	35 + IF	45 + IF	55 + IF
Noise sensitive premises: any area other than highly sensitive area	All hours	60	75	80
Commercial premises	All hours	60	75	80
Industrial and utility premises other than those in the Kwinana Industrial Area	All hours	65	80	90
Industrial and utility premises in the Kwinana Industrial Area	All hours	75	85	90

Note: The L_{A10} noise level is the noise that is exceeded for 10% of the time.
The L_{A1} noise level is the noise that is exceeded for 1% of the time.
The L_{Amax} noise level is the maximum noise level recorded.
IF = Influencing Factor

It is a requirement that noise from the site be free of annoying characteristics (tonality, modulation and impulsiveness) at other premises, defined below as per Regulation 9 ‘Intrusive or dominant noise characteristics’. Where the above characteristics are present and cannot be practicably removed, the following adjustments are made to the measured or predicted level at other premises.

TABLE 2.3.3 – ADJUSTMENTS FOR ANNOYING CHARACTERISTICS WHEN MUSIC IS NOT PRESENT

Where tonality is present	Where modulation is present	Where impulsiveness is present
+ 5 dB	+ 5 dB	+ 10 dB

Note: Where music is present the adjustment is +10 dB, and is +15dB if impulsiveness is present. The adjustments are cumulative to a maximum of 15 dB.

If the Regulations applied to the site Village the external noise criteria at night would be an L_{A10} of 35 dB(A).

2.3 CRITERIA SUMMARY

A summary of the recommended acoustic and vibration assessment criteria for the identified noise sensitive receptors is provided in Table 2.4.1.

TABLE 2.4.1 –NOISE AND VIBRATION ASSESSMENT CRITERIA

Assessment Parameter	Village	Station Homesteads
Air Blast Overpressure, dB L _{Z peak}	115 @	115
Continuous Noise, External dB(A) **	50 **	35 (30) #

Note: # -(xx) Compliance noise level if the noise emission has ‘tonal characteristic’ at the receptor.

** - External to buildings to comply with AS2107:2000 internal noise criteria of (35) dB(A) for Village.

@ - airblast criteria for site Village is not mandatory requirement, client may adopt own criteria.

3. METHODOLOGY

3.1 AIR-BLAST OVERPRESSURE

Blasting will only occur during daylight hours, so acoustic modelling is based on daytime climatic conditions. Soundplan is a complex acoustic prediction software capable of taking acoustic barrier and wind effects into consideration.

Air-blast overpressure noise emissions have been predicted using acoustic software SoundPlan. The input data for blast sound power has been determined using in-house acoustic data based on the blast Maximum Instantaneous Charge (MIC) within 8 milli-second (mS) time window.

Unless otherwise noted all predictions are for 'worst case' wind conditions of 4 m/s from source to receiver. Predictions have been made for a Maximum Instantaneous Charge (MIC) of 1000 Kg. Where air-blast overpressure noise emissions are likely to be of concern the blast engineer may reduce the MIC to achieve a reduced noise emission, however unless special measures such as addition of overburden are utilized, the reduction achievable is no more than 10 dB.

Corrections for a different MIC are:

TABLE 3.1 –CORRECTIONS FOR REDUCED MIC FROM BASE OF 1000 KG

MIC (Kg)	Correction, dB
1000	0
435	-3
295	-4
130	-7
2000	+2.5
4000	+5

There are a number of factors that affect blast noise emissions, including the local geology, direction of blast pattern and effectiveness of stemming. Variation from the predicted level is expected, normally within 10 dB of the predicted level, although care in planning and stemming the blast can reduce the risk of high deviations.

3.2 NOISE EMISSIONS

Noise levels were predicted using the acoustic software SoundPlan using the Concawe algorithm for nominated direction wind conditions in accordance with the Western Australian Environmental Protection Authority EAG 13, and the meteorological factors for modelling outlined in section 6.4.2 of the "Draft Guidelines on Environmental Noise for Prescribed Premises (May 2016)". The sound power levels used in the acoustic modelling are tabulated in the Appendix A.

It is noted that 'worst case' wind conditions refer to conditions where there is a temperature inversion in conjunction with light winds in the direction from noise source to receiver, resulting in effective sound propagation receiver locations. The night scenarios (including all mining scenarios but not blasting) are modelled with temperature inversion conditions.

4. BLAST, NOISE AND VIBRATION EMISSIONS

4.1 PREDICTED AIR-BLAST OVERPRESSURE

The predictions for proposed blasting operations at the mining pits indicate typical ‘worst case’ airblast overpressure levels for blasting at the existing pit surface.

TABLE 4.1 –WORST CASE PREDICTED AIRBLAST FROM PITS AT RECEPTORS

PIT	AIRBLAST NOISE		
	VILLAGE	EDMUND STATION HOMESTEAD	GIFFORD CREEK HOMESTEAK
Acoustic Criteria	115 L_{Z,Peak} #	115 L_{Z,Peak}	115 L_{Z,Peak}
Yangibana North	95	100	91
Bald Hill	99	91	94
Frasers	102	88	97
Future	118#	89	103

Note: # A level of 120 L_{Z,Peak} may be acceptable if blasts occur during normal non-sleep periods for both day and night shifts.

Predicted airblast noise emissions from blasting with a normal charge of 1000Kg MIC are expected to be acceptable at the site Village and nearest Station Homesteads for all pits. The Future Pit is nearest the site Village and management of blast noise may be required to ensure that night-shift personnel are not awoken at the time of blasting. It is understood that the Future Pit size has not yet been accurately defined. Management methods may include the time of blasting, blasting during favourable wind conditions or reduced MIC. Once the pit is developed and blasting is below natural ground level, barrier effects may reduce noise emissions to receptors.

5. MINING NOISE EMISSIONS

5.1 EXISTING BACKGROUND NOISE

Existing background noise allows for comparison with future predicted levels in terms of potential impact on the site Village and Station homesteads. Measurement of background noise at remote locations can result in noise levels as low as 20 dB(A) for periods when winds are calm and insect noise is not significant. Typically however, background noise varies between 25 – 40 dB(A) with wind induced noise from moving tree leaves a common noise source. Trees such as gum trees may not be particularly common in some areas, however it is common for shade trees to be planted around established receptors such as the Station homesteads. Noise sensitive receptors often have infrastructure which generates additional noise, power stations, air conditioning, pumps and the like.

There is no requirement to measure background noise at Yangibana. There are no other significant pre-existing noise sources in the area. The assessment criteria in Western Australia are not based on background noise, being objective criteria with defined emission criteria. The background noise from the natural environment will vary depending on climatic conditions and seasonal insect activity.

5.2 OPERATIONAL AND PROCESSING NOISE EMISSIONS

Three mining scenarios have been modelled.

The scenario presented in Run 151 is considered to be representative of proposed operations. Run 150 includes exploration of the Future Pit, as it is assumed that more detailed examination of this area will occur at some stage in the future. Run 152 is a hypothetical model of potential mining in the Future Pit area, carried out to provide the client with an indication of potential noise emissions to the Village.

The following equipment was modelled for the mining scenario.

- 21 x Cat 777D Haul Trucks
- 3 x Cat AD400 Articulated Haul Trucks
- 5 x Hitachi EX1100 Excavator
- 5x CAT 992G Loaders
- 4 x D10T Dozer
- 3 x CAT Graders
- 2 x CAT 854 Wheel Loaders
- 5 x Blast Drills
- Primary Mill & Secondary Mill
- Jaw Crusher and Cone Crushers
- Screens
- 6 x packaged Generators

The modelling is considered to be conservative, in practise not all of the mobile fleet will be operating at any one time due to servicing requirements and wait time for either the excavation or the transport equipment.

The predicted noise levels (worst case maximum) are:

TABLE 5.1 –WORST CASE PREDICTED NOISE EMISSIONS AT RECEPTORS

SCENARIO	AIRBLAST NOISE		
	VILLAGE	EDMUND STATION HOMESTEAD	GIFFORD CREEK HOMESTEAK
Acoustic Criteria	50 dB(A)	Night – 30 dB(A)	Night – 30 dB(A)
Scenario 1 - Mining	24	13	17
Scenario 2 – Mining & Future Pit exploration	34	13	18
Scenario 3 – Future Pit Mining	40	13	23

A highest predicted noise level of 40 dB(A) will be an acceptable noise level at the Accommodation Village, being within the AS2107:2000 criteria with a 10 dB(A) margin which allows for tonal characteristic if present. The impact on amenity is unlikely to be significant given the prevalence of air-conditioning units which generate background noise of similar levels at most mining accommodation villages. It may mean that mining activity is audible in some external areas at the accommodation village under particular wind conditions.

6. CONCLUSION

An assessment of proposed noise and vibration generating activities for the proposed mining operations at Yangibana has been carried out. The assessment covers the expected highest noise emissions from mining and processing at night. The blasting assessment covers all areas to be mined; the timing does not alter the maximum emissions as only one blast occurs at any one time.

Three sensitive receptor locations were identified. These are:

Site Village
Edmund Station homestead
Gifford Creek homestead

The site village is a client premises and therefore not legally required to comply with the 'assigned levels' of the *Environmental Protection (Noise) Regulations 1997*. However duty of care does place some responsibility to control noise levels at the Village. Generally air conditioning systems generate moderate levels of background noise within accommodation villages – the predicted noise emissions from mining operations are at a similar level being up to 40 dB(A) for potential future mining operations (Future Pit) nearest the Village. The predicted noise levels are expected to be within the recommended range under New Zealand/Australian 2107:2000.

Blasting is potentially the most significant operation with respect to noise impact. The distances to receptors are such that ground vibration will not be significant.

Airblast overpressure has been predicted for each of the existing and for the future deposits for standard blast charge of 1000Kg Maximum Instantaneous Charge (MIC). The predictions under worst case scenario are that airblast overpressure levels will be significantly below the normal Regulation criteria at the receptors compared to the criteria of 115 dB_{Zpeak}. When blasting the Future Pit, blast noise levels at the accommodation village may be as high as 118 dB_{Zpeak}, which is slightly above the regulation criteria. The regulatory criteria apply to receptors that are on other premises, the minesite has no constraints under the regulations with respect to noise generated within the site.

These predictions are for winds directed from the blast to the Village so the airblast overpressure levels will not be this high on all occasions. There may be the option to conduct blasting at the beginning or end of the dayshift when all personnel on site are awake and least likely to be affected if blast noise levels are identified as being an issue (Future Pit), or to conduct blasting when winds are not toward the Village.

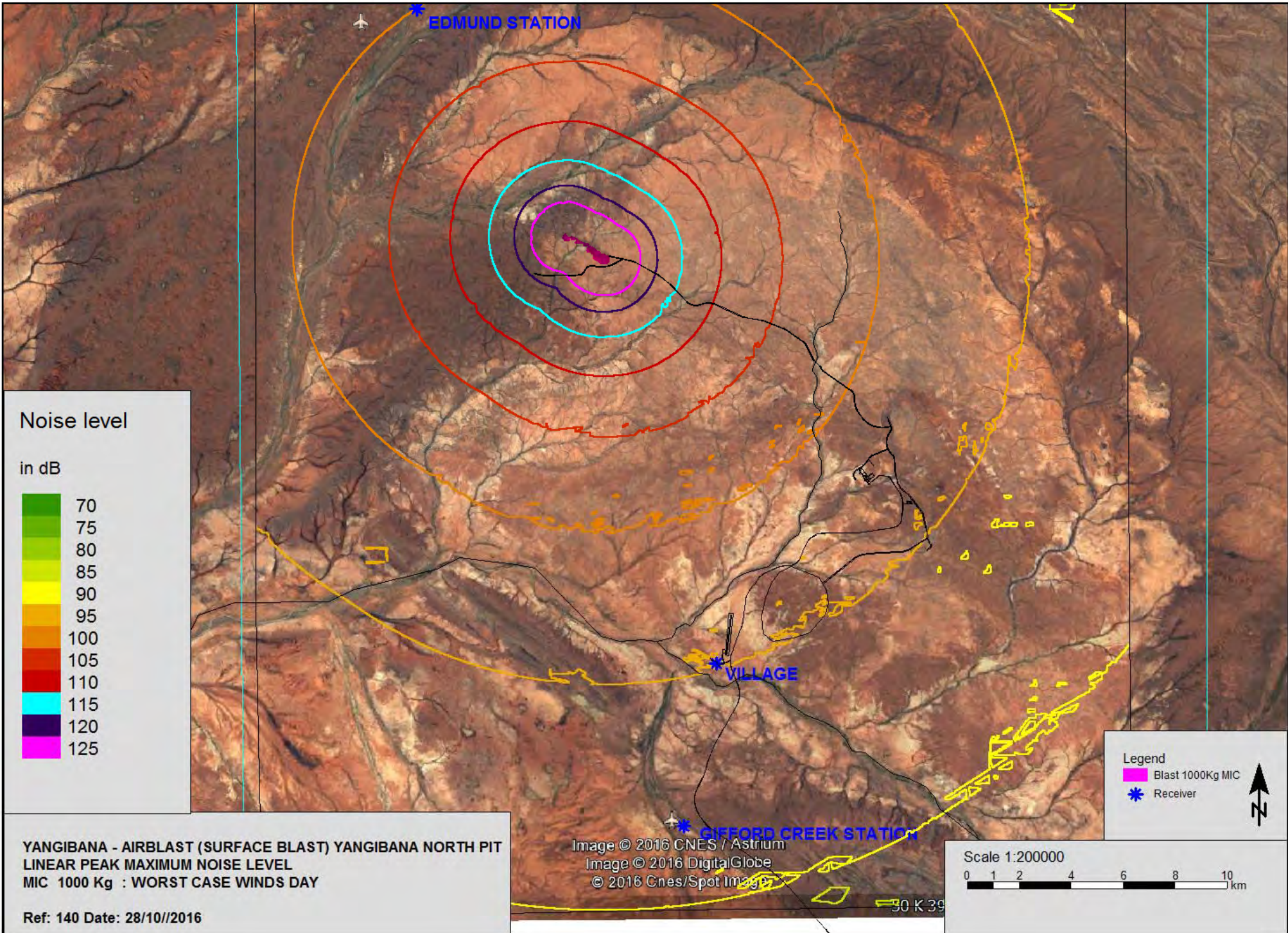
It is concluded that the noise emissions from the Yangibana Rare Earths Project will be acceptable at all receptors from mining and processing operations. Blast noise is also predicted to be acceptable for all pits except that the Future Pit has potential for slight exceedances of the regulation criteria of 115 dB_{Zpeak} under worst case wind conditions. However the Village is operated by the mine and compliance with this criteria is not mandatory. There are a number of options to manage blast noise to the Village from the Future Pit, including blasting during non-sleep hours, reduced charges, blasting during favourable wind conditions and reduced noise transmission when the pit is developed due to barrier effects.

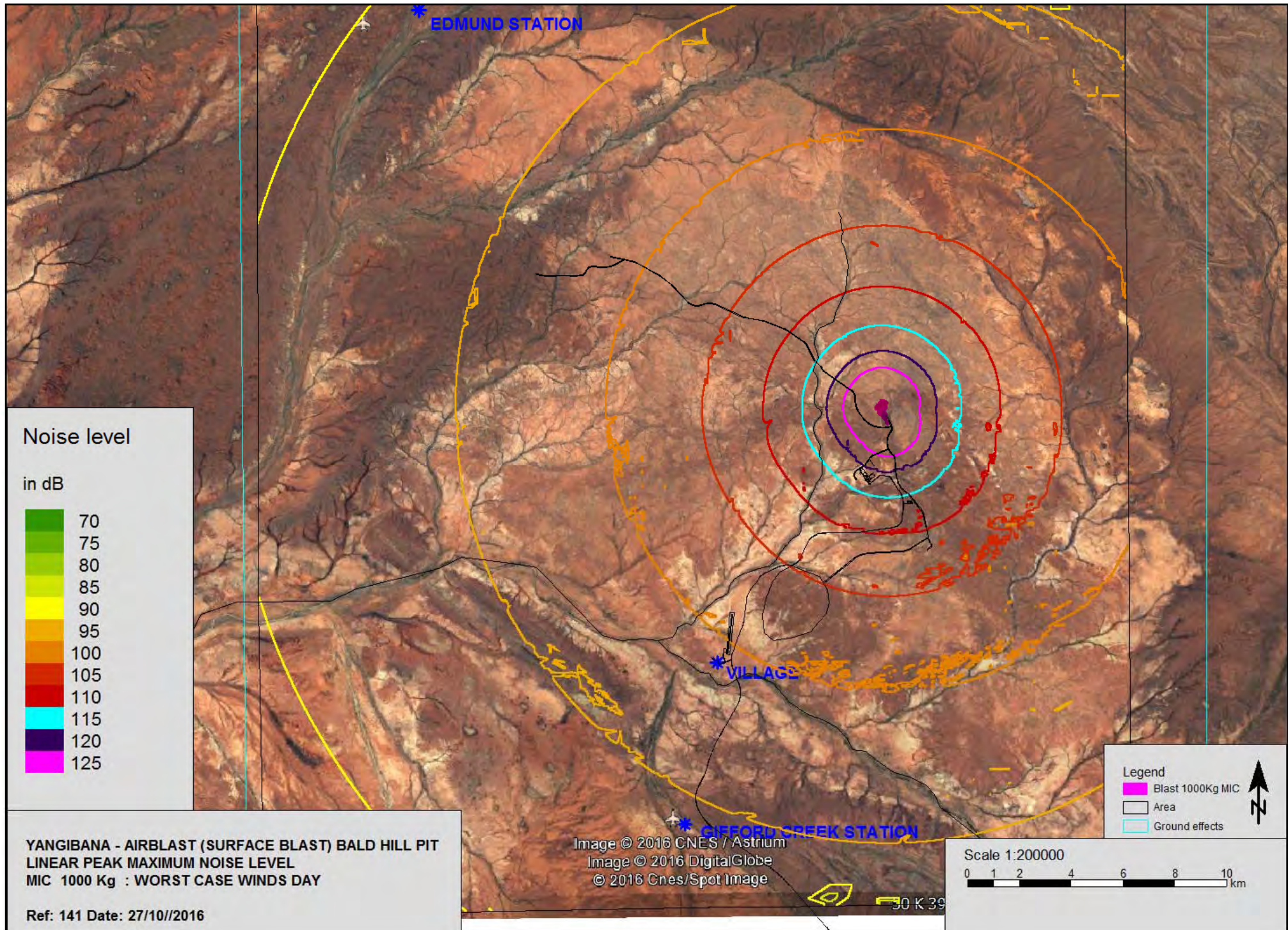
APPENDIX A

Sound Power Levels

APPENDIX B

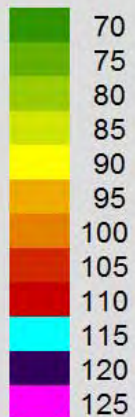
Air-blast Overpressure Noise Contour Plots





Noise level

in dB



**YANGIBANA - AIRBLAST (SURFACE BLAST) BALD HILL PIT
 LINEAR PEAK MAXIMUM NOISE LEVEL
 MIC 1000 Kg : WORST CASE WINDS DAY**

Ref: 141 Date: 27/10//2016

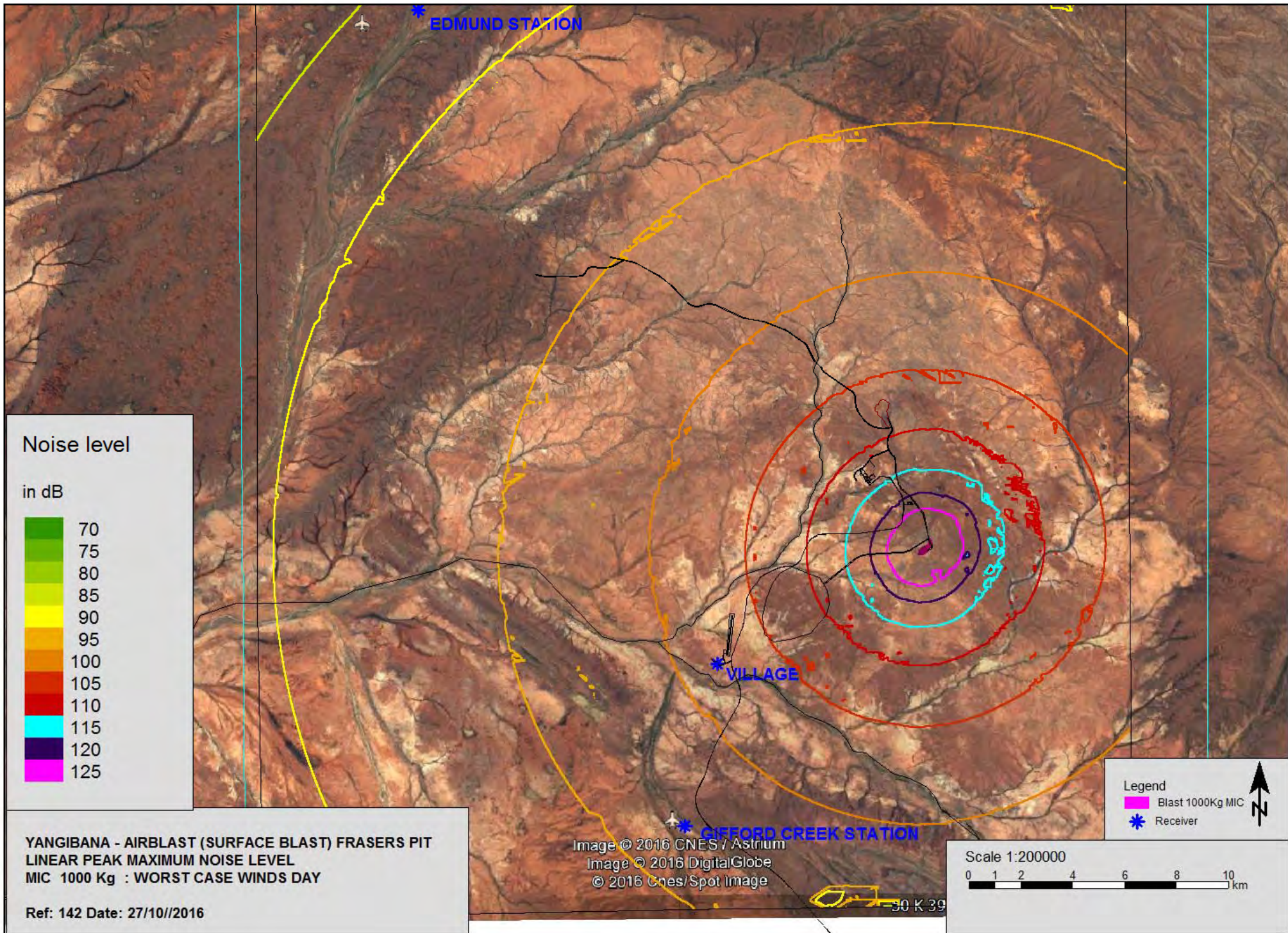
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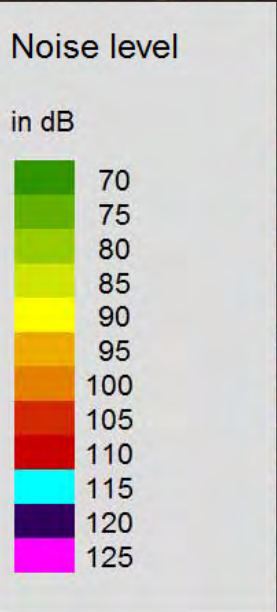
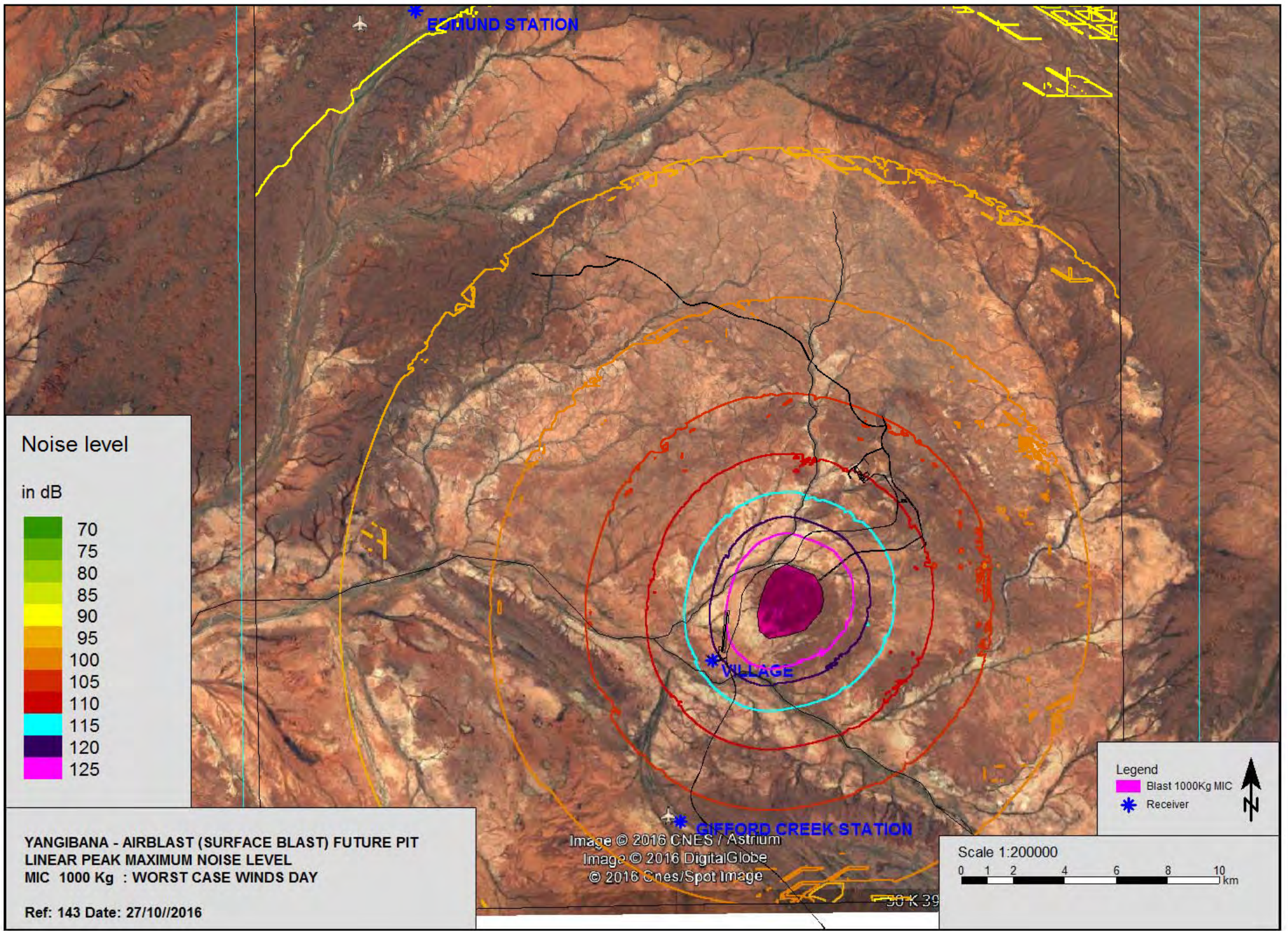
- Legend**
- Blast 1000Kg MIC
 - Area
 - Ground effects



Scale 1:200000







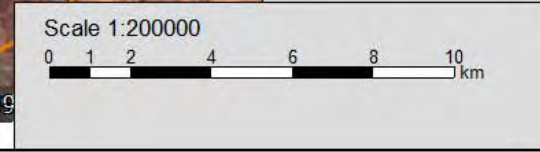
Legend

- Blast 1000Kg MIC
- ★ Receiver

**YANGIBANA - AIRBLAST (SURFACE BLAST) FUTURE PIT
 LINEAR PEAK MAXIMUM NOISE LEVEL
 MIC 1000 Kg : WORST CASE WINDS DAY**

Ref: 143 Date: 27/10/2016

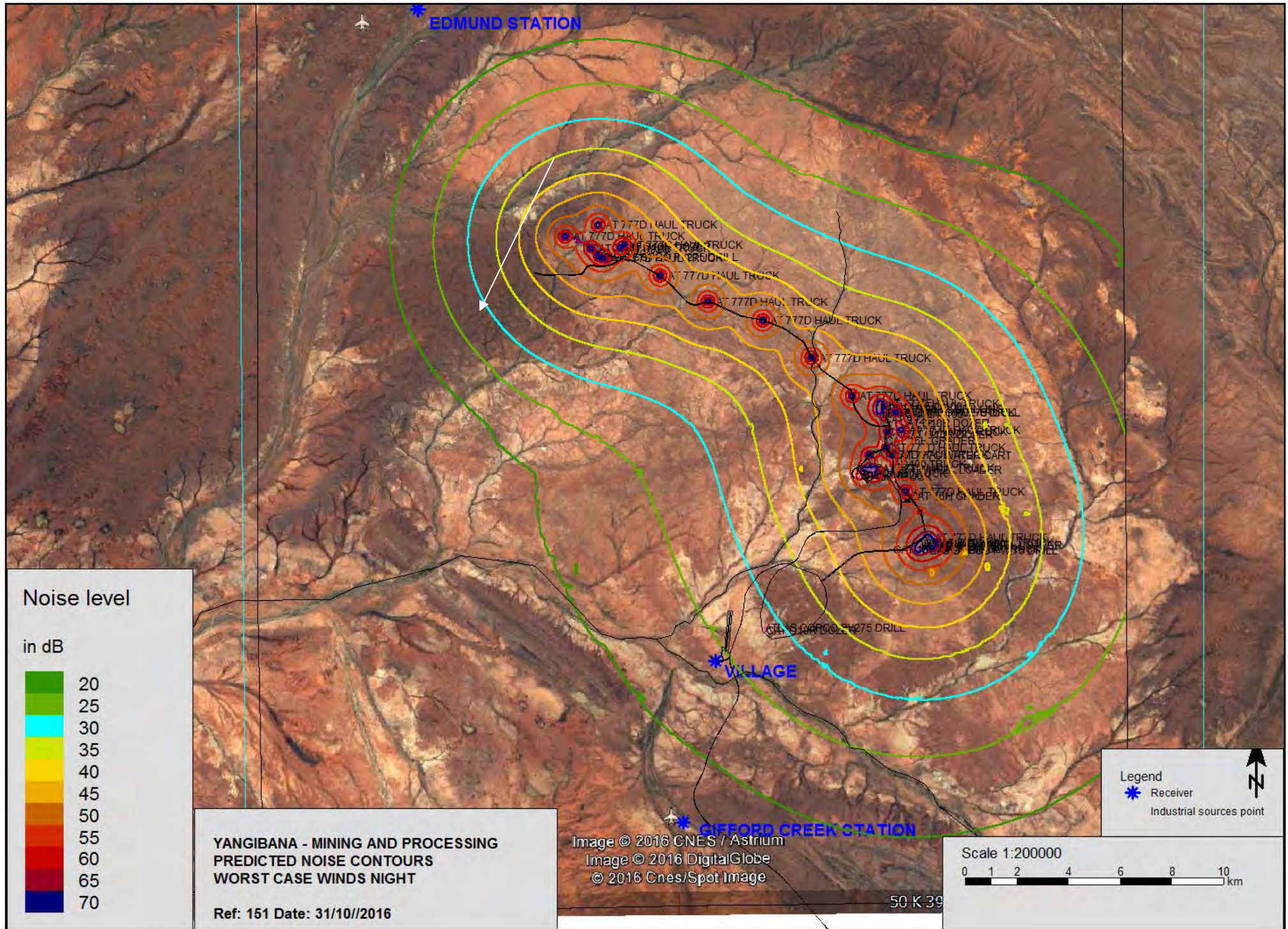
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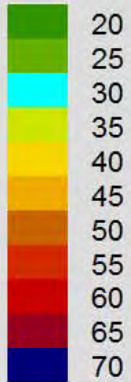
APPENDIX C

Mining Noise Contour Plots



Noise level

in dB



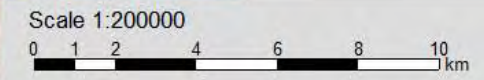
**YANGIBANA - MINING AND PROCESSING
PREDICTED NOISE CONTOURS
WORST CASE WINDS NIGHT**

Ref: 151 Date: 31/10/2016

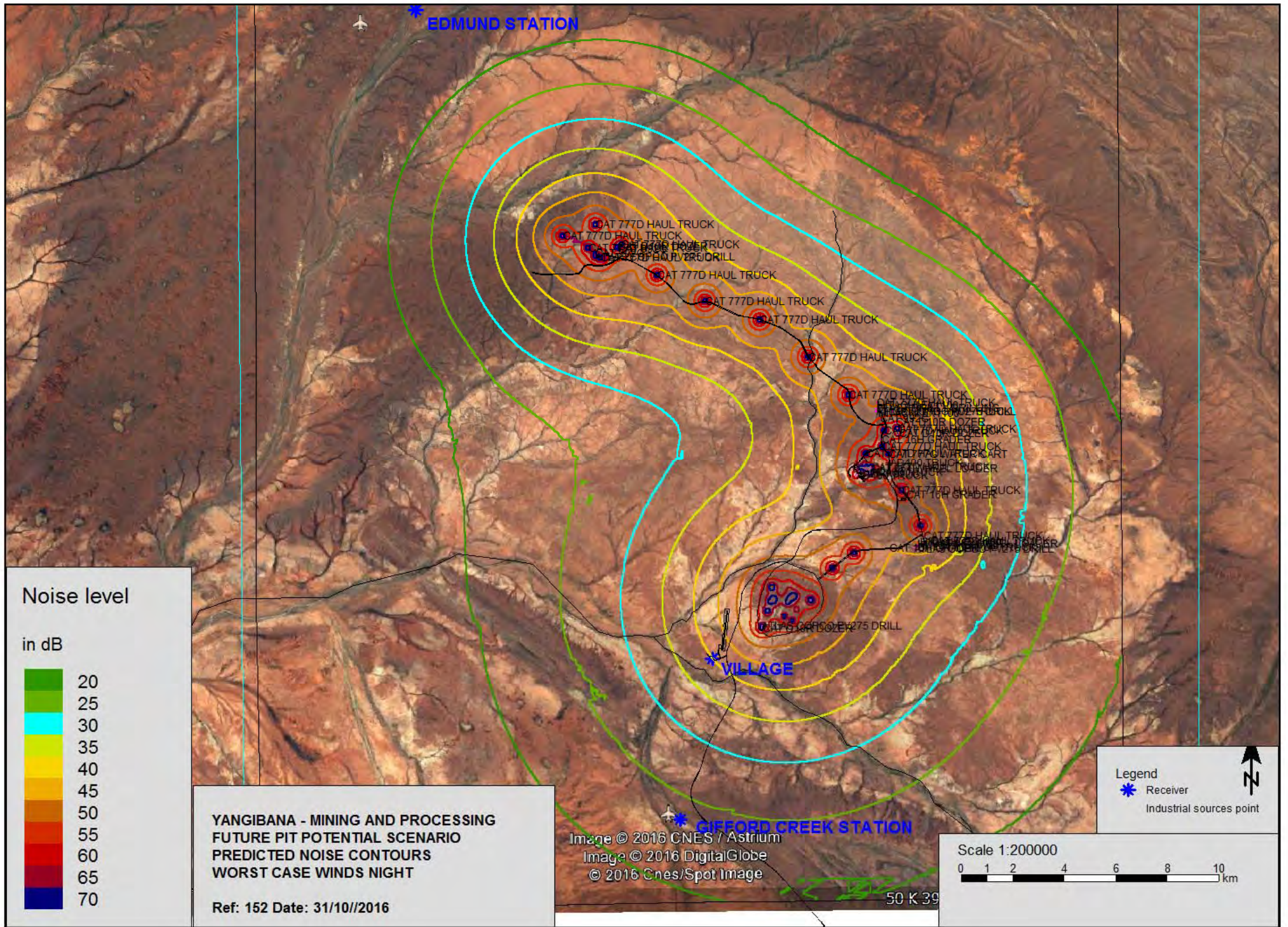
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Legend

- * Receiver
- Industrial sources point

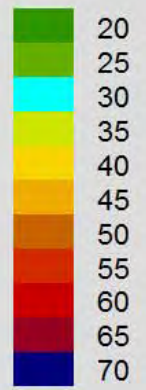


50 K 39



Noise level

in dB



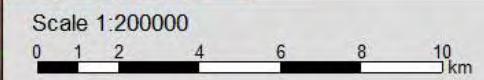
**YANGIBANA - MINING AND PROCESSING
 FUTURE PIT POTENTIAL SCENARIO
 PREDICTED NOISE CONTOURS
 WORST CASE WINDS NIGHT**

Ref: 152 Date: 31/10//2016

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Legend

- * Receiver
- Industrial sources point



50 K 39