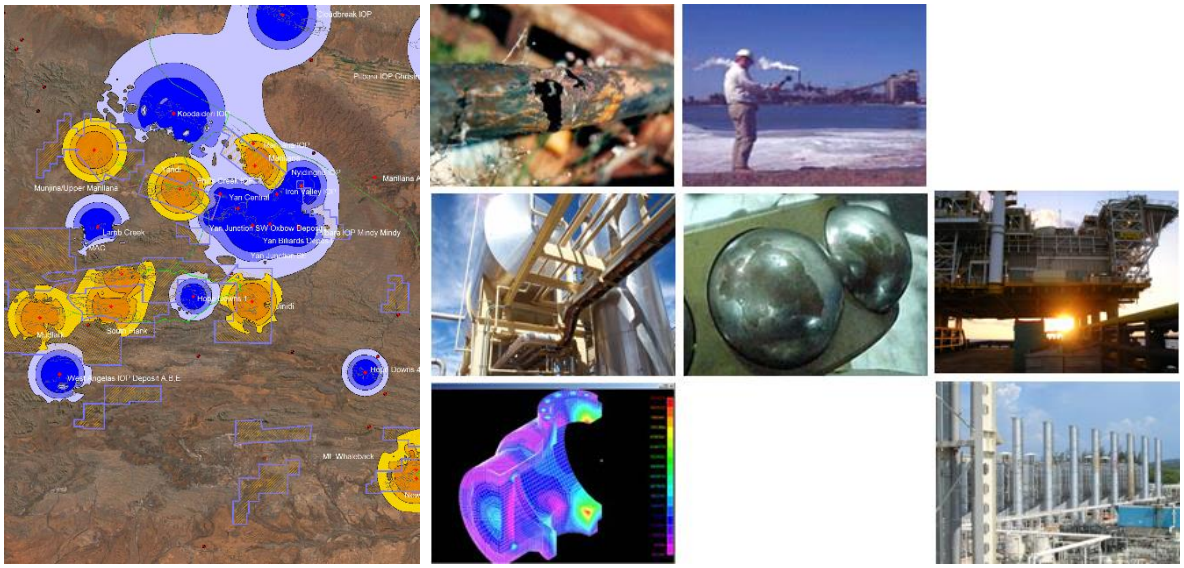
SVT ENGINEERING CONSULTANTS

CUMULATIVE NOISE IMPACT ASSESSMENT FOR THE STRATEGIC PROPOSAL



BHP BILLITON IRON ORE PTY LTD

1370205-2-100-Rev4-31 Aug 2015

DOCUMENT CONTROL & REVIEW INFORMATION

Client: **BHP Billiton Iron Ore Pty Ltd**

Client Contact: **Fabienne Hill Faskel & Lisa Reilly**

SVT Contact: **Granger Bennett**

SVT Office: **Perth**

SVT Job No: **1370205**

SVT Document No: **1370205-2-100-Rev4-31 Aug 2015**

Rev	Description	Prepared	Reviewed	Date
4	Final Issue	Luke Adams Maya Maroef	Shane Hashim (BHP)	31 Aug 2015
3	Updated with minor project changes	Luke Adams Maya Maroef	Granger Bennett (SVT) Lisa Reilly (BHP)	15 May 2015
2	Issued to Client	Maya Maroef	Luke Adams (SVT) Granger Bennett (SVT)	19 January 2015
1	Draft – issued for client comments	Milan Stojiljkovic	Fabienne Hill Faskel (BHP)	01 August 2014
0	Draft circulated for comments	Milan Stojiljkovic	Luke Adams (SVT) Granger Bennett (SVT)	24 July 2014

SVT Engineering Consultants
ABN: 18 122 767 944

SVT Perth (HEAD OFFICE)	SVT Brisbane Office	SVT Kuala Lumpur Office	SVT Bangkok Office
112 Cambridge Street West Leederville WA 6007 Australia Tel: + 61 (0)8 9489 2000 Fax: + 61 (0)8 9489 2088 Email: mailbox@svt.com.au	Level 10, 320 Adelaide St Brisbane, Queensland 4000 Australia Tel: +61 (0)7 3010 9528 Fax: +61 (0)7 3010 9001 Email: mailbox@svt.com.au	SVT Engineering Malaysia Sdn Bhd No A-2-6, Jalan SS7/13B, Aman Seri, Kelana Jaya, 47301 Petaling Jaya, Selangor, Malaysia Tel: +6.03.7877.2690 Fax: +6.03.7877.2689 Email: mailbox@svt.com.au	SVT Engineering Consultants (Thailand) MD Tower Bangna Complex Bangna, Bangkok 10260, Thailand Tel: +66 02 1864 961 Fax: +66 02 1864 960 Email: mailbox@svt.com.au

EXECUTIVE SUMMARY

Overview

SVT has undertaken an environmental noise impact assessment as part of BHP Billiton Iron Ore's Strategic Proposal (the Strategic Proposal) in the Pilbara region of Western Australia. The noise impact assessment involves development of a cumulative noise model for the Pilbara region with two focus areas:

- Central and Eastern Pilbara region where the mining hubs are located; and
- Northern Extension which comprises a strip of land surrounding the Port Hedland rail line.

The noise impact assessment includes mining operations managed by BHP Billiton Iron Ore and third-party projects within the strategic assessment area.

Objectives

The objectives of the cumulative noise impact assessment for the Strategic Proposal were to:

1. Quantify the cumulative noise impacts from BHP Billiton Iron Ore's current and future mining operations and rail transport on noise sensitive receivers across the Strategic Proposal area;
2. Quantify the cumulative noise impacts from current and foreseeable third-party projects on noise sensitive receivers across the Strategic Proposal area;
3. Assess the cumulative noise impacts from 1 and 2 combined; and
4. Assess compliance with the applicable noise legislation for operations and transport noise at noise sensitive receivers.

Assessment Criteria

The cumulative noise impact assessment for the Strategic Proposal includes human and fauna noise sensitive receivers spread across the strategic assessment area. The criteria used to evaluate human noise sensitive receivers are summarised in Table E - 1.

Table E - 1 Summary of environmental noise and rail noise criteria for The Strategic Proposal

Noise-sensitive Receiver	Time of Day	Noise Criteria
MINING OPERATIONS		
Residential Dwellings	22:00 - 07:00 Mon. – Sat. 22:00 - 09:00 Sun. and Public Holiday	L_{A10} = 35 dB(A)
Recreational sites, lookouts, rest stops and cultural sites	22:00 - 07:00 Mon. – Sat. 22:00 - 09:00 Sun. and Public Holiday	L_{A10} = 60 dB(A)
RAIL OPERATIONS		
Residential Dwellings	07:00 – 22:00 All days	L_{Aeq} = 55 dB(A) Noise Target L_{Aeq} = 60 dB(A) Noise Limit
Residential Dwellings	22:00 – 07:00 All days	L_{Aeq} = 50 dB(A) Noise Target L_{Aeq} = 55 dB(A) Noise Limit

Noise impacts on fauna have not been assessed as part of the scope of this report. Modelling outputs, however, have been provided in a format suitable for a third-party fauna specialist to conduct an assessment of noise impacts on fauna within The Strategic Proposal area.

Noise Modelling

Noise impacts were assessed by means of a cumulative noise model incorporating all existing and foreseeable future BHP Billiton Iron Ore operations within the Strategic Proposal area. Also considered are third-party mining operations located within 50 km from a BHP Billiton Iron Ore current or planned future operational hub. The noise model was developed using export tonnage as the means to define the noise emissions from each mining hub and rail segment in the project area.

The following three scenarios were modelled to assess the Strategic Proposal noise impacts:

1. **Current Disturbance Scenario** based on actual production rates for 2013;
2. **30% Development Scenario** based on the production rate associated with approximately 30% of BHP Billiton Iron Ores future identified projects being in concurrent operation; and
3. **Full Development Scenario** based on the production rate associated with full development of BHP Billiton Iron Ores future identified projects being in concurrent operation.

Results and Conclusions

The predicted noise levels are presented and discussed as point receiver results (Section 5.1) and noise contour maps (Section 5.2).

For operations noise, the noise model predicts the following;

- Current Disturbance Scenario - No exceedence of the noise criteria.
- 30% Development Scenario - One exceedance at the Township of Newman (PR07) caused by BHP Billiton Iron Ore mining activities, and the other at the Marillana Homestead (PR03) caused by a third-party proponent.
- Full Development Scenario - One exceedance at the Township of Newman (PR07) caused by BHP Billiton Iron Ore mining activities, and the other at the Marillana Homestead (PR03) caused by a third-party proponent.

All other noise sensitive receiver locations were predicted to be compliant with the Environmental Protection (Noise) Regulations 1997 for operations noise.

Noise sensitive receivers were also assessed for transportation noise impacts from BHP Billiton Iron Ore operated rail network. All assessed locations are predicted to be compliant with the noise criteria shown in Table E - 1.

As predicted by modelling, a number of sensitive receiver locations are approaching the project environmental noise criteria. These receiver locations are Tom Price Town centre (PR08) and Capricorn Roadhouse (PR13).

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Introduction

SVT has undertaken an environmental noise impact assessment as part of BHP Billiton Iron Ore's Strategic Proposal (the Strategic Proposal) in the Pilbara region of Western Australia (see Section 2 for details). The noise impact assessment involves development of a cumulative noise model for the Pilbara region with two focus areas:

- Central and Eastern Pilbara region where the mining hubs are located; and
- Northern Extension which comprises a strip of land surrounding the Port Hedland rail line.

1.2 Objectives

The objectives of the cumulative environmental noise impact assessment for the Strategic Proposal were to:

1. Quantify the cumulative noise impacts from BHP Billiton Iron Ore's current and future mining operations and rail transport on noise sensitive receivers across the Strategic Proposal area;
2. Quantify the cumulative noise impacts from current and foreseeable third-party projects on noise sensitive receivers across the Strategic Proposal area;
3. Assess the cumulative noise impacts from 1 and 2 combined; and
4. Assess compliance with the applicable noise legislation for operations and transport noise at noise sensitive receivers.

1.3 Scope of Work

The scope of the report covers the following objectives for the Strategic Proposal:

- Determination of typical baseline[1] noise levels from existing and proposed BHP Billiton Iron Ore mining and rail operations covered under the Strategic Proposal;
- Determination of typical baseline noise levels from estimated mining operations undertaken by third-party projects within the Strategic Proposal area;
- Modelling to predict the cumulative noise impacts from BHP Billiton Iron Ore and third-party mining operations;
- Assessment of potential noise impacts on sensitive receivers resulting from BHP Billiton Iron Ore's operations, including cumulative impacts from other existing and proposed projects; and
- Determination if any areas could be classed as high-risk and may require further attention and examination of the activities which contribute the most significant noise outputs.

[1] Baseline noise levels were determined from comprehensive noise models rather than measurements.

1.4 Exclusions

The following exclusions and limitations apply:

- Rail was not modelled for third-party proponent operations;
- Noise impacts on fauna were not assessed[2] as part of the scope of this report;
- Future developments at Yarrie and Goldsworthy hubs were not considered as they are outside the Strategic Proposal area; and
- Developments at Port Hedland were not considered as they are outside the Strategic Proposal area[3].

1.5 Applicable Legislation

1. Environmental Protection (Noise) Regulations 1997: Summary of Regulations, Department of Environmental Protection, Government of Western Australia, 1997.
2. National Environment Protection Council (Western Australia) Act 1996, Government of Western Australia, 1996.
3. State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning, Western Australian Planning Commission - Government Gazette, WA, 2009.
4. Implementation Guidelines for State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning, Western Australian Planning Commission, 2009.
5. Guidance for the Assessment of Environmental Factors – Environmental Noise, Draft No.8, Environmental Protection Authority, May 2007.

1.6 Abbreviations

SEA	Strategic Environmental Assessment
DER	Department of Environment Regulation
SPP5.4	State Planning Policy 5.4
MAC	Mining Area C
DGM	Digital Ground Model
SPL	Sound Pressure Level
SWL	Sound Power Level (also denoted as L_W)
BHPBIO	BHP Billiton Iron Ore Pty Ltd
RTIO	Rio Tinto Iron Ore Pty Ltd
HI	Hamersley Iron Pty Ltd
IO Holdings	Iron Ore Holdings Ltd
FMG	Fortescue Meals Group Ltd

[2] Linear model predictions for noise impacts on fauna were provided for third-party specialists.

[3] Port Hedland rail line was modelled along the Northern Extension.

2. PROJECT OVERVIEW

2.1 The Strategic Proposal project description

BHP Billiton Iron Ore is undertaking a regional Strategic Environmental Assessment for it's Strategic Proposal, which includes proposed future mines and associated infrastructure developments in the Central and Eastern Pilbara region.

The SEA comprises the Strategic Proposal and Strategic Assessment, which are being undertaken under State and Commonwealth legislation respectively.

The Strategic Proposal is defined as all of its proposed mining and associated infrastructure development activities within defined boundaries in the Pilbara. Subject to express exclusions, the Strategic Proposal includes all greenfields mine development, involving resources in which BHP Billiton Iron Ore currently has an interest or may acquire an interest in in the future, and brownfields development of existing assets. Figure 2-1 presents the Strategic Proposal locality map. The configuration and location of mines and hubs may change in the future, for example in response to newly identified resources, as a result of technology advances or to avoid environmental impacts.

Detailed engineering has not yet been undertaken for all of the elements of the Strategic Proposal. Elements of the Strategic Proposal will include infrastructure typically used in Pilbara iron ore operations including crushers, conveyors, ore-handling and screening plants, stockpiles and train load-out facilities, rail loops, workshops, warehousing, concrete batching plants, administration facilities, refuelling facilities, laydown and storage areas, power and water distribution infrastructure, waste disposal, wastewater treatment, dangerous goods and hazardous materials storage facilities, water treatment facilities and surface water management infrastructure. Beneficiation facilities with associated tailings dams may also be proposed for some operations. Road and rail networks to access these operations and allow the transportation of ore will also be required.[4]

The Strategic Proposal also includes supporting infrastructure related to these operations including, but not limited to rail spurs, conveyors, worker accommodation, water and gas pipelines, power lines, access roads, telecommunications, airports or helipads and water bores.

The alignments of rail corridors as shown in Figure 2-1 are conceptual only, and may change in the future in response to resource knowledge, processing design and size of plants, commercial agreements with other parties, or technology change. A conceptual rail spur linking the proposed Rocklea operations to BHP Billiton Iron Ore's rail network (existing or proposed) has not yet been identified. Development of any future rail corridors will seek to avoid impacts on areas of high environmental value and conservation estate.

The Strategic Proposal also encompasses potential capacity upgrades of the Newman to Port Hedland rail line, from the Newman mining hub to the 26 km chainage mark near Port Hedland. This mark represents the boundary of Projects environmentally approved by other mechanisms, outside of the Strategic Proposal area.

No specific timeframe applies to the Strategic Proposal. It is anticipated that operations will be progressively developed over the next 100 years.

[4] Typical activities listed in the above paragraph are those that form the noise inputs to the model.

A detailed map of the BHP Billiton Iron Ore and third party operations within the Strategic Proposal area are presented in Figure 2-2 (Current), Figure 2-3 (30% Development Scenario) and Figure 2-4 (Full Development Scenario).

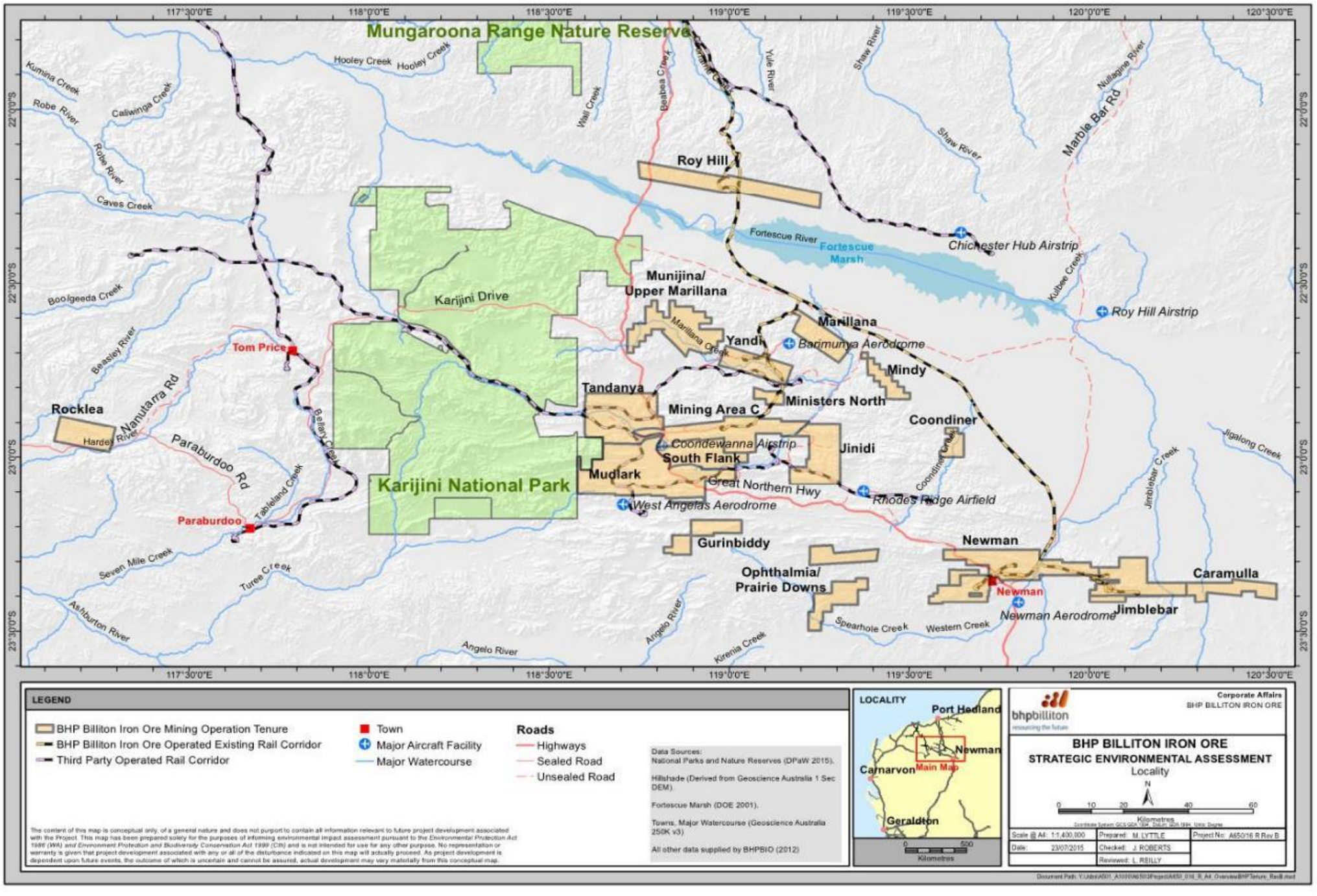


Figure 2-1 The Strategic Proposal Locality Map

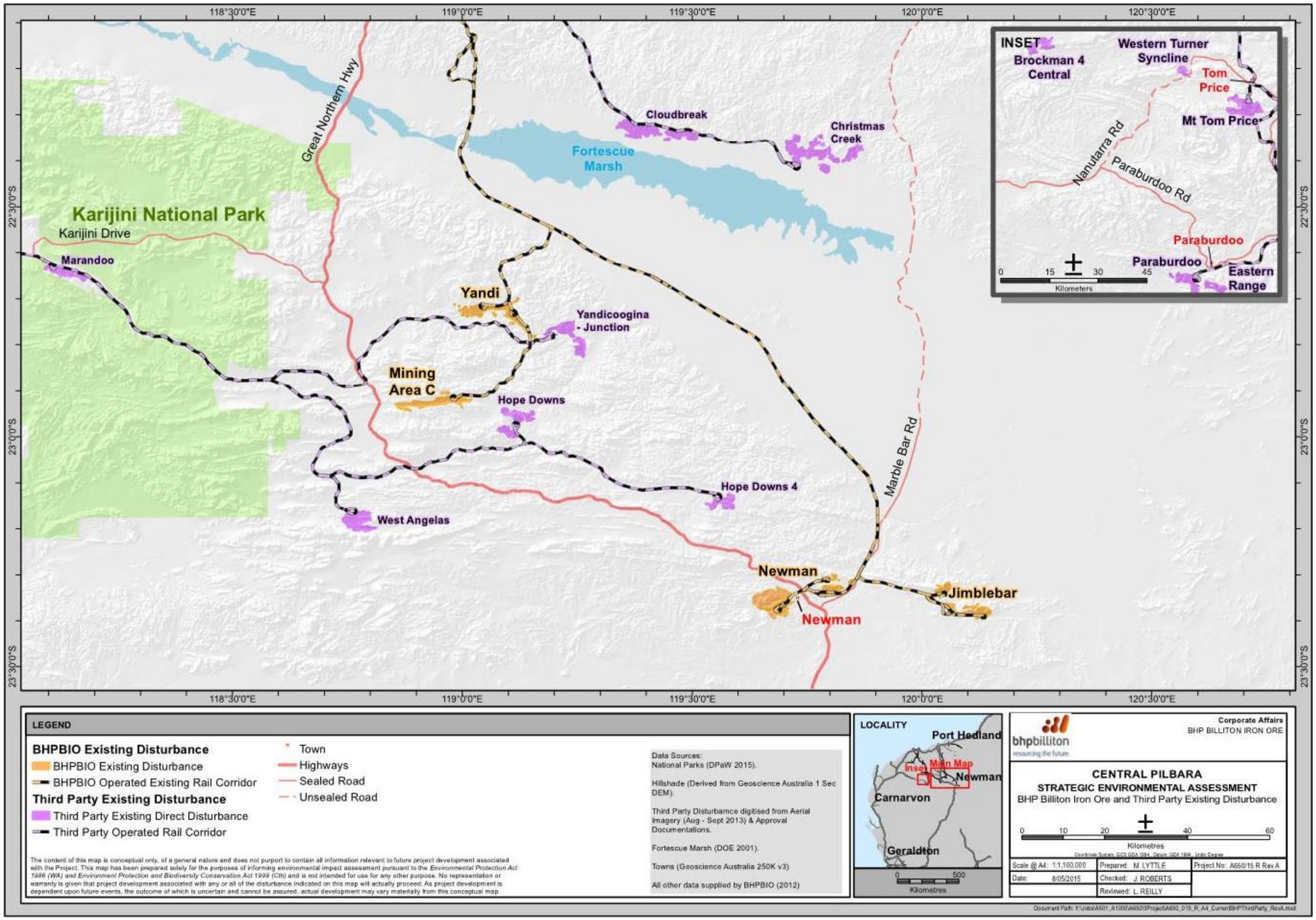


Figure 2-2 BHP Billiton Iron Ore and Third Party Current Disturbance Areas

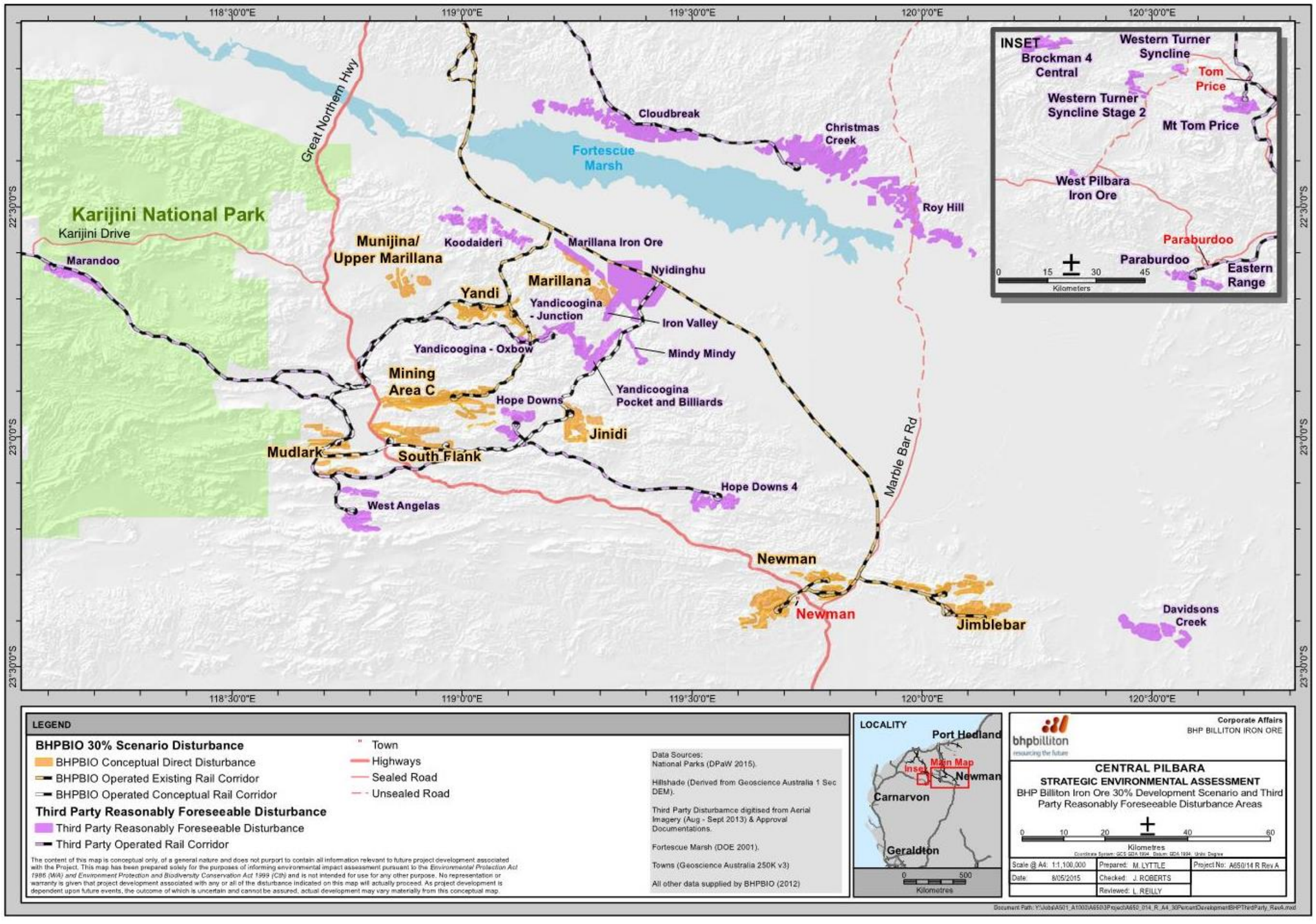


Figure 2-3 BHP Billiton Iron Ore 30% Development Scenario and Third Party Reasonably Foreseeable Disturbance Areas

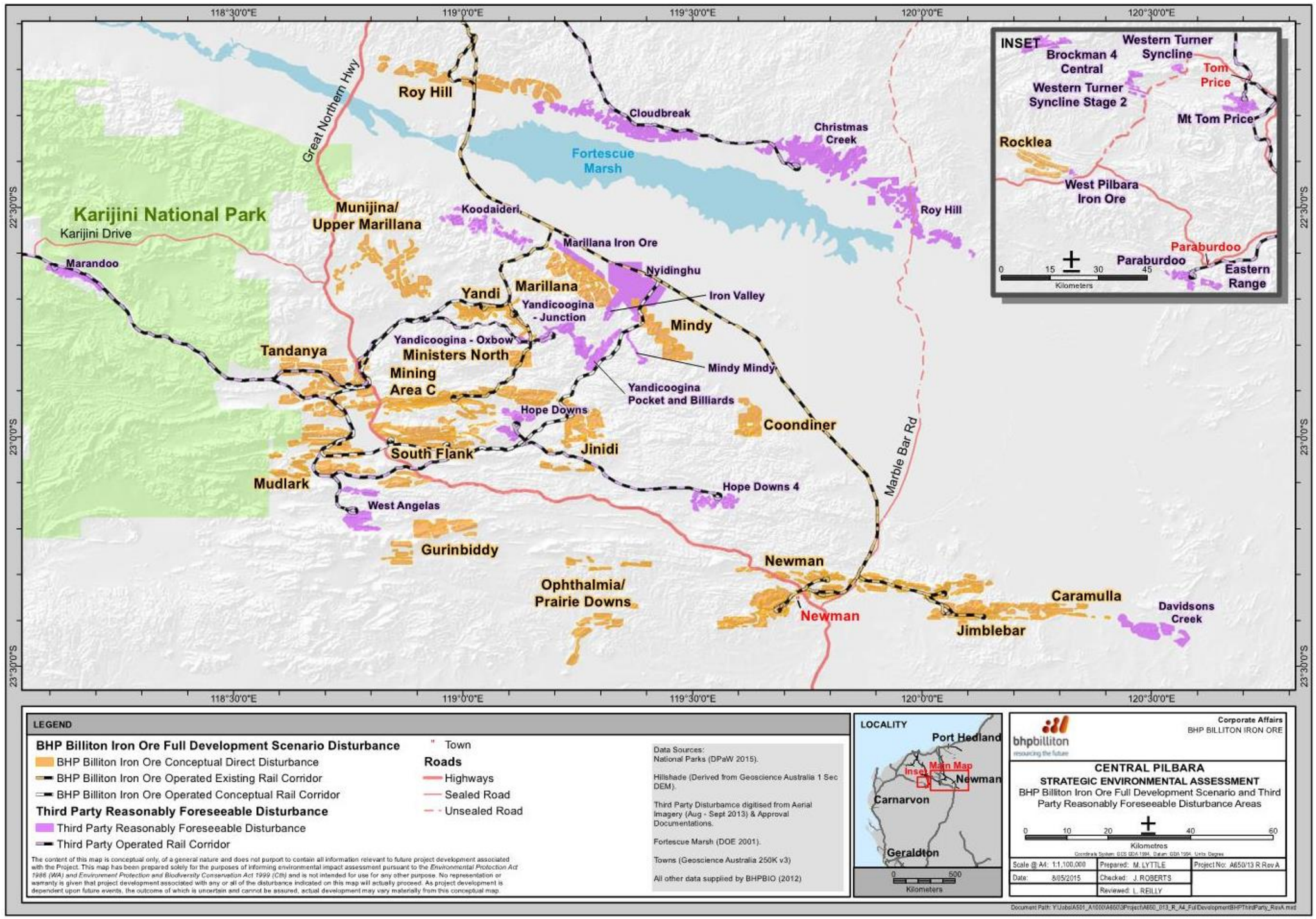


Figure 2-4 BHP Billiton Iron Ore Full Development Scenario and Third Party Reasonably Foreseeable Disturbance Areas

2.2 The Strategic Proposal Operational Hubs and Processing Hubs

In order to assess cumulative environmental noise impacts for the Strategic Proposal, all of BHP Billiton Iron Ore's current, and reasonably foreseeable future, mining operations are considered.

BHP Billiton Iron Ore's mining operations consist of operational hubs and processing hubs. Operational hubs represent mining activities including one or more processing facilities (depending on the mining strategy). Processing hubs represent locations where mined ore is processed, stockpiled and loaded for transport.

For the purposes of cumulative noise impact assessment, it is assumed that each processing hub will include the following noise generating activities:

- Haul roads
- Loading and unloading (ore and waste)
- Blasting
- Crushing (including primary and secondary crushing) and screening
- Stacking / reclaiming
- Rail load out
- Miscellaneous transfers

Given that not all of these activities will occur for all processing hubs (e.g. some operational hubs will have primary processing only rather than secondary processing and ore handling), this approach is considered conservative. Processing hubs may include ancillary infastructure such as administration buildings and accommodation villages. Given that the future locations of this infrastructure is unknown, and that they are not key noise-generating activities, these locations are not considered in this noise assessment.

The Strategic Proposal cumulative noise impact assessment has been based on:

- The construction and operation of the following mining operations:
    - Caramulla
    - Coondiner
    - Gurinbiddy
    - Jinidi
    - Marillana
    - Mindy
    - Ministers North
    - Mudlark
    - Munjina / Upper Marillana
    - Ophthalmia / Prairie Downs
    - Rocklea
    - Roy Hill
    - South Flank
    - Tandanya
- Future expansions to existing operations at Mining Area C (MAC), Yandi, Newman and Jimblebar; and
- Capacity upgrades to Newman to Port Hedland rail line, including spurs to existing/proposed operations.

Exclusive of the Strategic Proposal are:

- Existing BHP Billiton Iron Ore's operations and infrastructure;
- Future development of BHP Billiton Iron Ore's northern Pilbara operations at Yarrie and Goldsworthy and associated infrastructure; and
- Development and operations at Port Hedland, including rail to the 26 km chainage mark.

However, for the purposes of the Strategic Proposal noise impact assessment, existing BHP Billiton Iron Ore's mining and rail operations are included to provide a reference for comparison with future operations and rail infrastructure upgrades.

Future operational hubs were based on project assumptions for the purpose of the Strategic Proposal, and may (in the future) be divided into more processing hubs, or combined into larger processing hubs (e.g. South Flank into MAC processing hub). Therefore, the designation of future hubs was based on assumptions for the purpose of this environmental impact assessment.

Table 2-1 summarises the operational and processing hubs used in the Strategic Proposal noise assessment.

Table 2-1 BHP Billiton Iron Ore operational hubs and processing hubs

Operational Hub	Processing Hub
Existing	
Newman	Orebody 18 Eastern Ridge (including Orebody 23, Orebody 24 and Orebody 25) Whaleback (including Wheelarra, Orebody 18, Orebody 29, Orebody 30)
Mining Area C	Mining Area C
Yandi	Yandi West Yandi East
Jimblebar	Jimblebar East Jimblebar West
Future	
Newman	Orebody 31
Mining Area C	Packsaddle East
Carramulla	Carramulla
Coondiner	Coondiner
Gurinbiddy	Gurinbiddy
Jinidi	Jinidi
Marillana	Marillana
Mindy	Mindy
Minister's North	Minister's North
Mudlark	Mudlark
Munjina / Upper Marillana	Munjina / Upper Marillana
Ophthalmia / Prairie Downs	Ophthalmia / Prairie Downs
Rocklea	Rocklea
Roy Hill	Roy Hill
South Flank	South Flank
Tandanya	Tandanya

Table 2-2 shows the scenarios and assumptions applicable to the Strategic Proposal. Production rates for the Current Snapshot for BHP Billiton Iron Ore processing hubs are based on actual tonnages. Production rates for future BHP Billiton Iron Ore's processing hubs (i.e. 30% Development scenario and Full Development Scenario) are assumed to be 45 Mtpa. Given that some processing hubs will not include all activities at each location (i.e. some processing hub locations may be considered satellite orebodies and may not include secondary crushing), this is considered to be a conservative approach and is fit-for-purpose for cumulative noise impact assessment.

Table 2-2 Scenarios and assumptions for noise modelling

Scenario	Assumptions for processing rates	
	BHP Billiton Iron Ore	Third-party
Current Scenario	Actual tonnages supplied by BHP Billiton Iron Ore.	Approved production capacity for those projects for which some development has occurred, as verified by aerial imagery as at June 2012.
30% Development Scenario	45 Mtpa across all future BHP Billiton Iron Ore processing hubs scheduled to have commenced operations in the Alternative 3A mine plan, plus 45 Mtpa at existing processing hubs	Maximum approved production capacity for all third-party projects.
Full Development Scenario	45 Mtpa across all future and existing processing hubs.	Maximum approved production capacity for all third-party projects.

2.3 Third-party Projects

Third-party projects considered in the assessment are those that have been approved or are underway as at June 2012 (time of referral of Strategic Proposal to State environmental regulatory authority). Aerial imagery (as at 16/09/2013) was used to identify those projects that are currently active. Only third party iron ore projects within 50 km of a BHP Billiton Iron Ore's SEA operational or proposed future hub are included in the assessment. The exception is Roy Hill Iron Ore Mine (Roy Hill Iron Ore Holdings Pty Ltd), which has been included because of its close proximity to Fortescue Marsh.

Production rates for third-party iron ore projects are assumed to be at production capacity (either approved or proposed) for the Current and 30% Development Scenarios. Actual production rates for the Current Snapshot could not be used as this information is not publicly available for all proponents that have been identified as currently active. Where production capacity for third-party iron ore projects was not publicly available, a production capacity of 45 Mtpa was assumed.

List of third-party inclusions forming part of the cumulative noise impact assessment is given in Table 4-3, Section 4.2.3.

3. APPLICABLE LEGISLATIVE REQUIREMENTS

This section outlines the nature of industrial and transportation noise impacts expected as a by-product of mining operations in the Central and Eastern Pilbara region, as well the applicable noise legislation to regulate these impacts.

Separate criteria apply to industrial noise (e.g. mining operations) and transportation noise (e.g. rail operations), of which the first group is prescriptive in nature, and the second is given in form of guidelines and target limits.

3.1 Noise Criteria for Mining Operations

Mining operations fall within the category of complex industrial noise sources which have a high potential to adversely affect the environment. This is mainly due to a large number of noisy fixed plant and mobile equipment scattered over a relatively large area. Furthermore, mining operations are typically continuous (24 h per day and seven days per week), which may lead to significant behavioural disturbances of the exposed population even when adverse health effects are not likely. In addition, noise from mining operations is often tonal or impulsive in nature and, as such, can cause nuisance and be difficult to mitigate.

Environmental noise management is implemented in Western Australia through the Environmental Protection (Noise) Regulations 1997 [1], which operate under the Environmental Protection Act 1986 [2]. The Regulations specify maximum noise levels (i.e. assigned noise levels) that can be received at noise-sensitive premises, commercial premises and industrial premises. The assigned noise levels have been set differently for each type of premise (see Table 3-1).

Table 3-1 Assigned noise levels for different types of noise sensitive premises

Type of premises receiving noise	Time of Day	Assigned Level dB(A)		
		L_{A10}	L_{A1}	L_{Amax}
Noise sensitive premises: highly sensitive area	07:00 to 19:00 hours Monday to Saturday	45 dB(A) + influencing factor	55 dB(A) + influencing factor	65 dB(A) + influencing factor
	09:00 to 19:00 hours Sundays and public holidays	40 dB(A) + influencing factor	50 dB(A) + influencing factor	65 dB(A) + influencing factor
	19:00 to 22:00 hours all days	40 dB(A) + influencing factor	50 dB(A) + influencing factor	55 dB(A) + influencing factor
	22:00 hours on any day to 07:00 hours Monday to Saturday and 09:00 hours Sunday and public holidays	35 dB(A) + influencing factor	45 dB(A) + influencing factor	55 dB(A) + influencing factor
Noise sensitive premises: any area other than highly sensitive area	All hours	60 dB(A)	75 dB(A)	80 dB(A)
Commercial premises	All hours	60 dB(A)	75 dB(A)	80 dB(A)
Industrial and utility premises	All hours	65 dB(A)	80 dB(A)	90 dB(A)

For noise-sensitive premises (i.e. residences) an 'influencing factor' based on the land use within a 450 m radius from the noise receiver is added to the assigned levels. Within this radius, the influencing factor may introduce adjustments of up to about 20 dB, taking into account:

- The proportion of industrial land use zonings;
- The proportion of commercial zonings; and
- The presence of major roads.

The time of day also affects the assigned levels for noise-sensitive premises, yielding a +5 dB adjustment for night-time conditions (22:00-07:00 h).

The Regulations recognise three types of assigned noise levels:

- L_{Amax} signifies a noise level which is not to be exceeded at any time;
- L_{A1} signifies a noise level which is not to be exceeded for more than 1% of the time;
- L_{A10} signifies a noise level which is not to be exceeded for more than 10% of the time.

L_{A10} is the most applicable metric for predicting continuous industrial noise. L_{A1} and L_{Amax} are typically more associated with field measurements of sporadic noise events occurring under normal operating conditions. Therefore, L_{A10} metric will be used to assess noise impacts of the Strategic Proposal.

Noise levels at the receiver are also subject to adjustments if the noise exhibits intrusive or dominant characteristics, i.e. if it is impulsive, tonal or modulated[5].

3.1.1 Application of the Environmental Protection (Noise) Regulations 1997 to The Strategic Proposal

Table 3-2 shows the assigned levels (L_{A10}) established as the Strategic Proposal environmental noise limits for all identified groups of human sensitive receivers. The limits are conservative in nature and are representative of the worst-case night-time conditions.

The assigned noise level of 60 dB(A) for recreational sites, lookouts, rest stops and cultural sites has been determined based on the assumption that these areas will be occupied intermittently and for short periods of time. In addition, these sites are not necessarily associated with highly noise sensitive areas.

[5] The measured or predicted noise levels are increased by the highest applicable adjustment (up to 15 dB) if more than one dominant characteristic is present, and the adjusted noise levels must comply with the assigned levels.

Table 3-2 Environmental noise limits applicable to The Strategic Proposal

The Strategic Proposal Environmental Noise Limits		
Noise-sensitive Receiver	**Time of Day**	**Assigned Noise Level**
Residential Dwellings	22:00 - 07:00 Mon. – Sat. 22:00 - 09:00 Sun. and Public Holiday	35 dB(A)
Recreational sites, lookouts, rest stops and cultural sites	22:00 - 07:00 Mon. – Sat. 22:00 - 09:00 Sun. and Public Holiday	60 dB(A)

Detailed noise input data are currently not available for most processing hubs, and therefore the adjustments for intrusive or dominant noise characteristics are not taken into account.

Influencing factors for noise-sensitive premises are also not considered. This is mainly due to the regional (strategic) character of the assessment under which the prevailing land use conditions at sensitive receiver locations are not precisely known[6].

3.2 Noise Criteria for Rail Operations

Rail noise is managed in Western Australia through the State Planning Policy 5.4: Road and Rail Transport Noise and Freight Considerations in Land Use Planning (SPP 5.4 gazetted September 2009) [3] (SPP5.4), which was developed under the Planning and Development Act 2005 in consultation with the Department of Environment and Conservation, Main Roads WA, Public Transport Authority and the Western Australia Local Government Association.

The Policy is only triggered by certain activities

- New passenger and freight rail infrastructure projects;
- Major redevelopments of railways; and
- Minor redevelopments that are likely to adversely affect a noise-sensitive land use.

As defined in the Policy, a major railway redevelopment encompasses:

- A proposed substantial realignment, either inside or outside the existing corridor, or
- A rail duplication; or
- Works that significantly increase capacity.

According to the Policy, a minor redevelopment of a railway includes '*…minor works such as crossovers, sidings, turnouts, yards, loops, and refuges, relief lines, straightening of curves, re-sleepering or the installation of track signalling devices*'.

Furthermore, the Policy defines the outdoor noise assessment criteria (for humans) as '*…the criteria (that) are applicable to the emission of road and rail transport noise as received at a noise-sensitive land use. These noise levels apply at noise-sensitive receivers, at 1 m from the most exposed façade*

[6] For the most part, the land surrounding the noise sensitive receivers identified within the Strategic Proposal area is zoned for industrial use and, therefore, higher noise criteria than that adopted for the Project are applicable. The noise criteria chosen for the Project is thus conservative in nature, and reflects the possible inclusion of accommodation camps in future which are subject to more stringent noise criteria than industrial land.

of a habitable building, at each floor level, and within at least one outdoor living area on each residential lot'.

When predicting transport noise levels under this Policy, a +2.5 dB façade correction[7] may need to be applied for both road and rail. Façade correction does not apply to sensitive receivers located outdoors (i.e. locations not associated with existing or planned residential or commercial housing). Façade correction also does not apply to sensitive fauna receivers.

The 5 dB difference between the outdoor noise target and the outdoor noise limit, as prescribed in SPP5.4 [3] represents '*…an acceptable margin for compliance. In most situations in which either the noise-sensitive land use or the major road or railway already exists, it should be practicable to achieve outdoor noise levels within this acceptable margin'*.

For major and minor redevelopments the noise criteria specified in SPP5.4 [3] should be used only as guidance. The Policy recognises that '*…in a number of instances, it may not be reasonable and practicable to meet the noise target criteria. Where transport noise is above the target level, measures are expected to be implemented that best balance reasonable and practicable considerations, such as noise cost/benefit, feasibility, community preferences, amenity impacts, safety, security and conflict with other planning and transport policies. In these cases the community should also be consulted to assist in identifying best overall solutions*'.

Table 3-3 Outdoor noise criteria applicable at 1 m from the most exposed façade of a dwelling

Outdoor Noise Criteria (at 1 m from the most exposed façade of a dwelling)		
Time of Day	Noise Target	Noise Limit
Day (6 am – 10 pm)	55 dB(A)	60 dB(A)
Night (10 pm – 6 am)	50 dB(A)	55 dB(A)

Concerning the warning signals, the Policy '*…does not apply to warning devices installed on road and rail vehicles. Therefore, the policy is not applicable to Locomotive horns (used at road crossings)'* and hence locomotive horns and reversing beepers have not been considered in this assessment.

3.2.1 Application of the SPP 5.4 to The Strategic Proposal

Although the noise criteria outlined in SPP5.4 and reproduced in Table 3-3 are not applicable to all rail expansions for the Strategic Proposal[8], BHP Billiton Iron Ore will assess their rail noise impacts against the SPP5.4 criteria in all instances.

Table 3-4 presents the rail noise criteria applicable to the Strategic Proposal and representative of the worst-case night-time conditions.

[7] Under realistic measurement conditions, noise levels assessed at 1 m or 2 m from a building include additional sound energy reflected from a hard surface (i.e. building façade). In conceptual stages of strategic noise mapping, buildings are typically omitted from the model as they form part of future developments. Therefore, the predicted noise levels need to be corrected for 'measurement conditions' (i.e. with building present) before they are compared against the noise criteria.

[8] E.g. an increase in tonnage along a BHP Billiton Iron Ore operated railway does not trigger the Policy; however, a new rail segment does trigger the Policy.

Table 3-4 Outdoor noise criteria for rail operations applicable to The Strategic Proposal

The Strategic Proposal Rail Noise Limits		
Time of Day	Noise Target	Noise Limit
Night (10 pm – 6 am)	50 dB(A)	55 dB(A)

4. METHODOLOGY

The methodology used to model cumulative environmental noise impacts within the Strategic Proposal area is described in this section. First, the objective of strategic noise assessments and applicability to the Strategic Proposal is discussed. The steps undertaken to model these impacts are then elaborated in more detail, along with the methodology used to estimate the baseline noise levels used as inputs to the study.

4.1 Strategic Noise Assessments

4.1.1 General Approach

Strategic environmental noise maps provide a means of assessing environmental noise impacts from transportation networks (railways, roads and airport operations) and industrial activities, both taking place over a large area of interest and over a sustained period of time. Their primary objective is to provide a conservative estimate of the overall noise climate as a result of cumulative anthropogenic noise-generating activities.

The outcomes of strategic noise assessments are typically used as supporting information for environmental approvals, as well as to aid the stakeholders in the decision-making process when planning for project expansions and new operations, in considering the impacts to noise sensitive receivers.

Strategic noise assessments must be considered as a modelled output only which provides a guide for decision making on a regional scale.

4.1.2 The Strategic Proposal Noise Map

The cumulative noise impact assessment for the Strategic Proposal does not consider all anthropogenic noise emissions within the considered area, but focuses on mining operations managed by BHP Billiton Iron Ore. The mining hubs operated by third-party proponents within the Central and Eastern Pilbara region are also considered to an extent[9].

A high-level screening method was adopted by which noise from cumulative mining operations can be rapidly and efficiently modelled for strategic assessment purposes. The method also enables identification of operational components which may require detailed analysis due to their predicted impacts on noise sensitive receivers.

The screening method used to determine cumulative noise impacts and resulting considerations relies on direct correlation between the expected noise emission levels and tonnes mined from a given operation. For example, a typical mine site with a nominal capacity of 45 Mtpa requires a certain amount of infrastructure, fixed plant and mobile equipment, all of which are scalable based on the tonnes produced. This approach facilitates estimation of noise levels for mines having a nominal capacity other than the typical 45 Mtpa mine site.

[9] Noise impacts from third-party proponents are assessed without the rail component (i.e. only mining operations are considered) and are based on the iron ore throughput estimates provided by BHP Billiton Iron Ore.

4.2 Noise Modelling

4.2.1 Methodology Overview

The following methodology was adopted for developing a cumulative environmental noise model for the Strategic Proposal:

- A regional-scale noise model comprising BHP Billiton Iron Ore mining operations and third-party projects was developed on the basis of actual production rates for the existing mines and estimated production rates for proposed operations.

  The noise model relies on noise inputs established by correlating the noise emission levels and tonnes mined per annum (see Section 4.2.3).

- The model outputs (noise contours and noise levels at sensitive receiver locations) were used to determine high-risk mining hubs where project noise criteria may be exceeded.

  High-risk sensitive receiver locations were assessed on the basis of the most significant contributor. Particular attention was given to areas where significant noise impacts may occur as a by-product of operations managed by several proponents.

The assessment component of the study may identify mining hubs for which a more detailed analysis and modelling may be considered[10].

For the purposes of this study, a desktop noise model was developed using SoundPLAN sound propagation modelling software. The software predicts sound pressure levels at nominated receiver locations or equidistant grid points over a defined area of interest.

The main inputs to the model comprise noise source data (i.e. location, emission level in dB and daily period of activity), ground topographical data, meteorological conditions and sensitive receiver locations.

Topography provided by BHP Billiton Iron Ore covers the Central and Eastern Pilbara region where most mining hubs are located or will be constructed as part of proposed expansions[11]. The supplied topography was used to compute a digital ground model (DGM) from which ground elevations and barrier effects from landform were derived.

Ground type was specified as *moderately hard*[12] over the entire terrain for industrial noise predictions, and as *compacted field and gravel* with a *roughness class* set to 0.25 for rail noise predictions. This approach of specifying a homogenous ground type across the whole DGM is valid for strategic assessments, where detailed ground information would not yield any improvements in prediction outcomes.

Calculation algorithms used to predict the noise levels were as follows:

[10] I.e. a model comprising high-risk mine sites with detailed noise inputs and accurate spatial distribution for fixed plant and mobile equipment, as well as simplified mine sites previously used in the initial-pass noise model.

[11] Northern Extension which follows the main rail line up to Port Hedland has also been included.

[12] Ground absorption varies from a value of 0 to 1, with 0 representing an acoustically hard ground (e.g. concrete or water) and 1 representing acoustically absorbent ground (e.g. grass, snow). Moderately hard ground having a value of 0.6 represents an average for ground consisting of sand, rocks and bush.

1) CONCAWE algorithm was used for industrial noise predictions due to its capability to include weather impacts on sound propagation curvature[13]. The CONCAWE algorithm is conservative in nature and accepted by the Department of Environment Regulation (DER).

2) Nord2000 algorithm was employed for rail noise predictions as it enables detailed set-ups for meteorological conditions, train definitions and track conditions.

Meteorological conditions assigned to the model are in accordance with EPAs recommendations for worst-case weather conditions [5]:

- Day (07:00 - 19:00 h) wind speed – 4m/s; Pasquill stability class "E"; temperature - 20°C; and relative humidity – 50%.
- Night (19:00 – 07:00 h) wind speed – 3m/s; Pasquill stability class "F"; temperature – 15°C; and relative humidity – 50%.

These parameters reflect the impacts of wind direction, wind strength and temperature gradients from ground level to several hundred meters in height. Parameters reflecting night-time meteorological conditions were used to model the worst-case noise impacts for the Strategic Proposal.

Point receiver noise levels were calculated in third-octave bands at a height of 1.4 m above the ground[14] at locations identified as sensitive receivers within the Strategic Proposal area. Depending on the type of sensitive receiver, the predicted noise levels were either A-weighted (for human receivers) or linearly weighted (for fauna receivers).

Noise contour maps were calculated as broadband noise levels (both A-weighted and linear) at a height of 1.4 m above the ground at every 1 km for mining operations and every 0.5 km for rail operations. The overall noise levels cover a frequency span approximately from 20 Hz to 12 kHz.

4.2.2 Modelled Scenarios

The modelled scenarios reflect the requirements outlined in Section 2 and summarised in Table 2-2. For each of the three modelled scenarios[15] SVT have developed noise models to reflect the following:

- BHP Billiton Iron Ore mining operations;
- BHP Billiton Iron Ore rail operations;
- Mining operations by third-party proponents; and
- Cumulative impacts from BHP Billiton Iron Ore and third-party mining operations.

Noise impacts from mining and rail operations were modelled and assessed separately as the noise criteria outlined in Section 3 applies separately to industrial (i.e. mining) and transportation (i.e. rail) noise impacts.

The following model outputs were calculated for each scenario:

- A-weighted noise contours across the area covered by Strategic Proposal;

[13] Night-time is representative of worst-case sound propagation conditions, characterised by downward refracting wavefronts which lead to an increase in receiver noise levels in parts of the atmosphere close to the ground.

[14] Point receiver height was set to 0.5 for fauna sensitive receivers.

[15] Current Disturbance, 30% Development Scenario and Full Development Scenario.

- Linear noise contours across the area covered by Strategic Proposal; and
- A-weighted point receiver results for sensitive human receivers.

4.2.3 Noise Modelling of Mining Operations

The mining operations were modelled as point sources representative of processing hubs comprising both static plant and mobile equipment from one or more mining hubs. Each processing hub was assigned a noise emission level (sound power level), see Table 4-1, based on the estimated production rate in Mtpa, see Table 4-2 and Table 4-3.

Generic processing hub noise emission levels were derived from detailed desktop noise studies previously conducted by SVT for BHP Billiton Iron Ore. The following two comprehensive noise models were used to estimate the reference processing hub sound power levels (see Appendix H):

1. MAC environmental noise model for Expansion P1W and P1E which delivers 45 Mtpa of iron ore (and thus corresponds to a typical mine site production rate); and
2. Orebody 24 environmental noise model which is representative of a medium capacity mine with a production rate of 18 Mtpa.

The reference noise models listed above are representative of typical large and medium sized processing hubs comprising all mobile and static equipment required for extracting and processing iron ore.

Sound power levels for production rates other than 45 Mtpa and 18 Mtpa were derived from the reference sound power levels for six mining hub categories defined in Table 4-1[16]:

Table 4-1 Sound power levels for generic mining hub categories

Mining Hub Category Based on the Iron Ore Throughput in Mtpa	Octave Band Sound Power Levels Lw dB (linear)									Overall Lw dB(A)
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	
< 20 Mtpa	128	121	125	116	118	116	113	108	100	121
20 Mtpa - 30 Mtpa	134	127	131	122	124	122	119	114	106	127
30 Mtpa - 40 Mtpa	140	133	137	128	130	128	125	120	112	133
40 Mtpa - 50 Mtpa	138	139	141	137	137	133	130	125	119	138
50 Mtpa - 60 Mtpa	144	145	147	143	143	139	136	131	125	144
> 60 Mtpa	150	151	153	149	149	145	142	137	131	150

Production Rates for BHP Billiton Iron Ore Processing Hubs

Table 4-2 lists the production rates (supplied by BHP Billiton Iron Ore) for the existing and proposed BHP Billiton Iron Ore's processing hubs (see Table 2-1 for additional details). The table lists the processing hubs as they were entered into the noise model.

[16] Sound power level estimates are based on linear extrapolation yielding a difference of 6 dB between the categories.

Table 4-2 List of BHP Billiton Iron Ore processing hubs and their actual and estimated production rates

Mining Hub	Operator	Throughput in Mtpa as used for modelling scenarios		
		Current Disturbance Scenario Throughput	30% Development Scenario Throughput	Full Development Scenario Throughput
CURRENT OPERATIONS				
Mining Area C	BHPBIO	51.7	45	45
Yandi West	BHPBIO	36.8	45	45
Yandi East	BHPBIO	36.8	45	45
Whaleback	BHPBIO	55.2	45	45
Eastern Ridge	BHPBIO	9.4	45	45
Orebody 18	BHPBIO	14.6	45	45
Jimblebar East	BHPBIO	13.4	45	45
STRATEGIC PROPOSAL				
Roy Hill	BHPBIO	N/A	N/A	45
Rocklea	BHPBIO	N/A	N/A	45
Tandanya	BHPBIO	N/A	N/A	45
Mudlark	BHPBIO	N/A	45	45
South Flank	BHPBIO	N/A	45	45
Ophthalmia / Prairie Downs	BHPBIO	N/A	N/A	45
Gurinbiddy	BHPBIO	N/A	N/A	45
Mindy	BHPBIO	N/A	N/A	45
Marillana	BHPBIO	N/A	45	45
Coondiner	BHPBIO	N/A	N/A	45
Carramulla	BHPBIO	N/A	N/A	45
Minister's North	BHPBIO	N/A	N/A	45
Jinidi	BHPBIO	N/A	45	45
Munijna / Upper Marillana	BHPBIO	N/A	45	45
Packsaddle East	BHPBIO	N/A	N/A	45
Jimblebar West	BHPBIO	N/A	45	45

Production Rates for Third-party Proponent Operational Hubs

Table 4-3 lists the production rates (supplied by BHP Billiton Iron Ore) for third-party projects. The table lists the operational hubs as they were entered into the noise model.

Table 4-3 List of third-party proponents operational hubs and their estimated production rates

Mining Hub	Operator	Throughput in Mtpa as used for modelling scenarios		
		Current Disturbance Scenario Throughput	30% Development Scenario Throughput	Full Development Scenario Throughput
Koodaideri Iron Ore Project	RTIO	N/A	70	70
Nyidinghu Iron Ore Project	FMG	N/A	40	40
Davidsons Creek DSO	Atlas Iron	N/A	15	15

Mining Hub	Operator	Throughput in Mtpa as used for modelling scenarios		
		Current Disturbance Scenario Throughput	30% Development Scenario Throughput	Full Development Scenario Throughput
Pilbara Iron Ore Project - Mindy Mindy	FMG	N/A	45	45
West Angelas Iron Ore Project - Deposits A, B, E	Robe River Mining Co.	40	40	40
West Pilbara IOP	API	N/A	15	15
Western Turner Syncline - Stage 2 B1, S17 Deposits	RTIO	N/A	32	32
Yandicoogina - Junction SW, Oxbow Deposits	HI	N/A	27	27
Iron Valley IOP	IO Holdings	N/A	5	5
Brockman Syncline 4	HI	42	42	42
Cloudbreak IOP	FMG	50	50	50
Eastern Range - Paraburdoo	RTIO	45	45	45
Hope Downs 1	RTIO	30	30	30
Hope Downs 4	HI	30	30	30
Marandoo IOP	RTIO	16	16	16
Marillana IOP	Brockman Resources	N/A	19	19
Mt. Tom Price	RTIO	45	45	45
Pilbara IOP - Christmas Creek	FMG	45	45	45
Roy Hill IOP - Stage 1	Hancock Prospecting	N/A	65	65
Western Turner Syncline - Section 10	RTIO	25	25	25
Yandicoogina - Junction SE	HI	24	24	24
Yandicoogina - Central	HI	36	36	36
Yandicoogina - Pocket/Billiards Deposit	HI	N/A	70	70

4.2.4 Noise Modelling of Rail Operations

Rail noise impacts are directly related to the amount of iron ore extracted from BHP Billiton Iron Ore operated processing hubs. The production rate of each processing hub determines the number of trains (as well as the number of ore cars per each train[17]) required to transport the iron ore to Port Hedland. This in effect determines the number of train pass-by events (and thus the amount of noise exposure) that a sensitive receiver will be exposed to if located close to the railway line.

The Strategic Proposal rail noise model was developed by sub-dividing the rail footprint provided by BHP Billiton Iron Ore into separate rail sections for each processing hub. Each section was then associated with the following two components:

- A rail loop at the facility yard; and
- A 'straight' track segment[18] via which the iron ore is transported to the main Port Hedland line.

[17] All modelled trains consisted of two diesel engine driven locomotives pulling 134 ore cars, thus achieving the overall train length of 1437 m.

[18] In this context, 'straight' segment applies to all rail segments other than rail loops.

Furthermore, each component was allocated a track speed[19] and a number of train pass-by events derived from the throughput of a given processing hub. This information was then used to calculate the noise emission for each track component.

Finally, straight sections of the rail were joined into a main railway line which transports all iron ore extracted within the Central and Eastern Pilbara region to Port Hedland[20].

Sound Power Levels for Rail Operations

The sound power levels used to define noise emission from trains (see Table 4-4) are based on field measurements previously taken by SVT. The sound power levels are representative of a typical rake used in the Pilbara region by BHP Billiton Iron Ore.

Table 4-4 Sound power levels used to define noise emission from a typical Strategic Proposal freight train

Freight Train Components	Octave Band Sound Power Levels Lw dB (linear)									Overall Lw dB(A)
	31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1 KHz	2 KHz	4 KHz	8 KHz	
Ore Cars	85.5	88.7	87.3	93.1	80.9	72.0	77.8	70.9	62.0	87
Diesel Locomotive (main rail segments)	96.3	111.8	99.5	98.7	93.8	96.3	104.9	106.9	106.7	112
Diesel Locomotive (loop segments)	92.2	92.6	87.0	84.4	85.4	89.6	96.8	100.3	102.8	105

4.3 Model Assumptions

General assumptions applicable to the Strategic Proposal cumulative noise model are as follows:

- Ground type was set as uniform throughout the entire Strategic Proposal area;
- Worst-case night-time sound propagation conditions apply to all predictions;
- Elevation lines which form the DGM are entered in 100 m resolution; and
- Northern Extension terrain which follows the main Port Hedland rail line is used only to model the potential noise impacts close to the rail.

The noise model for mining operations has incorporated the following assumptions:

- Production rates of proposed expansions and future processing hubs are set as 45 Mtpa;
- Production rates for third-party iron ore projects are assumed to be at either approved or proposed production capacity;

[19] 70 km/h for the 'straight' track segments and 30 km/h through the facility yards.

[20] The tonnages from all modelled processing hubs were arithmetically added to arrive at the total amount of iron ore transported to Port Hedland via the main rail line.

- Where production capacity for third-party iron ore projects was not publicly available, a production capacity of 45 Mtpa was assumed;
- A direct correlation exists between the expected noise emission levels and tonnes mined from a given operation (for the purposes of strategic assessments, this relationship is assumed to be linear);
- Eastern Ridge serves as a processing hub for Orebody 23, Orebody 24 and Orebody 25;
- Whaleback serves as a processing hub for Wheelarra, Orebody 28, Orebody 29, Orebody 30 and Orebody 31; and
- Only third party iron ore projects within 50 km of a BHP Billiton Iron Ore SEA operational or processing hub are included in the assessment. The exception is Roy Hill Iron Ore Mine which has been included because of its close proximity to Fortescue Marsh.

The noise model for rail operations has incorporated the following assumptions:

- The frequency of rail movements is independent of date and time;
- The meteorological conditions are for still air at 15°C and 50% humidity;
- For rail assessment purposes, predicted noise levels for sensitive human receivers[21] associated with a dwelling have been corrected by +2.5 dB to account for façade reflection;
- Predicted noise levels for fauna receivers and human receivers located outdoors[22] have not been corrected for the presence of building facades;
- All rail movements are assumed to be loaded to provide for a conservative estimate and reduce the modelling effort due to the size of the Strategic Proposal railway[23];
- The number of rail movements in loops is half the number of movements in 'straight' track segments;
- Mining hubs without associated rail (Minister's North is processed at Yandi and Packsaddle East is processed at MAC) are assumed to transport the iron ore to processing facilities via trucks and conveyers; and
- For strategic modelling purposes, rail squeal noise was considered only within the facility yards[24].

[21] Listed in data supplied by BHP Billiton Iron Ore as: homestead, town centre, roadhouse, town site and Aboriginal community.

[22] Listed in data supplied by BHP Billiton Iron Ore as: rest top, lookout, recreation site, recreational camp, cultural site, conservation estate, threatened ecological community and important wetland.

[23] In reality, the number of empty ore car movements will be equal to the number of fully loaded ore car movements.

[24] Applying squeal noise corrections for every track curvature would be laborious considering the length of the modelled railway. Detailed squeal noise modelling will be undertaken for those track segments where noise levels at the closest receiver are predicted to be within 5 dB of the threshold level as defined in Table 3-4.

5. RESULTS AND DISCUSSION

5.1 Results for Noise Sensitive Receivers

5.1.1 Noise Impacts from Mining Operations

Table 5-1 shows the predicted noise levels at sensitive receiver locations due to mining operations for all three considered scenarios (i.e. Current Disturbance, 30% Development Scenario and Full Development Scenario). The table contains only those receivers for which the noise levels were predicted to be within 5 dB from the assigned level, and which are attributable in whole or in part by BHP Billiton Iron Ore's modelled activities. Detailed results for all sensitive receivers are given in Table F-1, Appendix F.

Table 5-1 Point receiver noise levels resulting from mining operations[25]

Receiver ID	Site Name and Description	CURRENT DISTURBANCE Predicted Noise Level in dB(A)			30% Development Scenario Predicted Noise Level in dB(A)			Full Development Scenario Predicted Noise Level in dB(A)			Assigned Level dB(A)
		BHPBIO	Third Party	Cum.	BHPBIO	Third Party	Cum.	BHPBIO	Third Party	Cum.	
PR03	Marillana *homestead*	18.2	23.5	24.6	27.6	**40.9**	**41.1**	29.2	**40.9**	**41.2**	35
PR07	Newman *town centre*	30.4	14.2	30.5	**38.2**	18.8	**38.2**	**38.3**	18.8	**38.3**	35
PR13	Capricorn *roadhouse*	26.8	9.7	26.9	30.4	15.3	30.5	30.5	15.3	30.6	35

The following conclusions can be made from Table 5-1 and Table F-1:

- The assigned noise levels were predicted to be exceeded at the following sensitive receiver locations:
  - Marillana Homestead (PR03) – the assigned level of 35 dB(A) was **exceeded** by 6.1 dB for the 30% Development scenario and Full Development scenario, with main noise contribution coming from third-party operations. BHP Billiton Iron Ore operations in isolation do not exceed the assigned levels at this receiver and contribute less than 1dB to the cumulative noise level at this receiver location.
  - Newman Town Centre (PR07) – the assigned level of 35 dB(A) was **exceeded** by approximately 3.3 dB for the 30% Development scenario and Full Development scenario, with the main contribution from BHP Billiton Iron Ore operations in both instances.
  - The predicted noise level at Capricorn Roadhouse (PR13) is about 4 dB below the assigned level of 35 dB(A) due to contribution from BHP Billiton Iron Ore operations for all modelled scenarios.

[25] Greyed out cells indicate the assigned noise level exceedances; bolded cells indicate noise levels within 5 dB from the assigned noise level.

- The assigned levels of 60 dB(A) were **not exceeded** for sensitive receivers located in outdoor areas (e.g. recreational sites, lookouts, rest stops etc.) for all modelled scenarios. The highest predicted noise level for these receiver types was 43 dB(A), which is 17 dB below the threshold criteria.

Based on the above, it can be concluded that the Strategic Proposal mining noise impacts on sensitive receivers will be below the project environmental noise limits, except in the case of Newman Town Centre (PR07) where the criteria was exceeded by 3.3 dB.

The prediction of noise level above the assigned level in Newman Town Centre (PR07) is based on high level regional assumptions and not detailed modelling of this existing operation. This assessment has shown that this area warrants more detailed investigation which should incorporate accurate noise emission levels for static and mobile equipment, as well their accurate spatial distribution.

In addition, the Tom Price Town Centre (PR08) and Capricorn Roadhouse (PR13) receivers are approaching the project environmental noise criteria, and may need to be monitored closely in case the scenario configurations change significantly.

5.1.2 Noise Impacts from Rail Operations

Table 5-2 shows the predicted noise levels at sensitive receiver locations due to rail operations within the Strategic Proposal area. The table contains the predicted noise levels for only the five highest receivers. Detailed results for all sensitive receivers are given in Table F-2, Appendix F.

Table 5-2 Point receiver noise levels resulting from rail operations

Receiver ID	Site Name and Description	CURRENT DISTURBANCE Predicted Noise Level in dB(A)	30% DEVELOPMENT SCENARIO Predicted Noise Level in dB(A)	FULL DEVELOPMENT SCENARIO Predicted Noise Level in dB(A)	Noise Limit (Target) dB(A)
PR03	Marillana *homestead*	29.9	34.7	34.7	50 (55)
PR07	Newman *town centre*	29.7	31.7	31.7	50 (55)
PR21	Ophthalmia Dam *recreation site*	25.9	31.2	31.2	50 (55)
PR22	Tower Hill *lookout*	30.0	32.0	32	50 (55)
PR25	Weeli Wolli Spring / Outfall *recreation site*	12.5	36.2	36.2	50 (55)

As can be seen from table 5-2, the noise limit of 55 dB(A) and the noise target of 50 dB(A) were both satisfied at all assessed noise sensitive receiver locations.

Noise sensitive receivers with the highest predicted rail noise impacts were:

- Marillana Homestead (PR03) - the noise target of 50 dB(A) and the noise limit of 55 dB(A) were **not exceeded** for any of the considered scenarios. This location corresponds to the sensitive receiver associated with a dwelling which received the highest rail noise impact. The maximum predicted noise level of 37 dB(A) is 13 dB below the noise target of 50 dB(A) and 18 dB below the noise limit of 55 dB(A).

- Weeli Wolli Spring/Outfall recreation site (PR25) - the noise target of 50 dB(A) and the noise limit of 55 dB(A) were **not exceeded** for any of the considered scenarios. This location corresponds to the sensitive receiver associated with outdoor (e.g. recreational) areas which received the highest rail noise impact. The maximum predicted noise level of 38 dB(A) is 12 dB below the noise target of 50 dB(A) and 17 dB below the noise limit of 55 dB(A).

It can be concluded that the Strategic Proposal rail noise impacts will not be significant and do not approach the target or limit criteria at any of the assessed sensitive receivers.

5.2 Noise Contours

Detailed noise contour maps of all modelled scenarios are provided in Appendices A to C. The noise contours shown in this section only depict those scenarios for which the environmental noise criteria were exceeded due to BHP Billiton Iron Ore's operations.

Figure 5-1 shows noise predictions for the Newman operational hub which predicted a noise criteria exceedance at the Newman Town Centre (PR07). Eastern Ridge was identified as the processing hub which contributed the most to the predicted noise levels at this location. Future processing may not necessarily occur at this exact location and has been used as a model only. Figure 5-1 is representative of the Full Development scenario, however, the same outcomes are predicted for the 30% Development scenario.

In addition, overlay[26] noise contour plots representative of BHP Billiton Iron Ore's operations and third-party proponent's operations are shown to indicate areas where more than one operator is expected to contribute to the cumulative noise levels.

Figure 5-2, Figure 5-3 and Figure 5-4 show the overlay noise contour maps for the Current Disturbance, 30% Development scenario and Full Development scenario, respectively. The images provide a close-up view of areas where more than one operator is expected to contribute to the cumulative noise levels. Full overlay noise contour maps for the Central and Eastern Pilbara area are given in Appendix D.

An important thing to note about noise contour maps is their coarse resolution[27]. As such, noise contour maps can only be used for the screening assessment purposes, i.e. it is not advisable to use them for compliance assessment against project noise criteria (as was the case for predicted point receiver noise levels).

[26] Overlay noise contour maps show independent noise impacts from BHP Billiton Iron Ore's operations (orange colour spectrum) and third-party projects (blue colour spectrum); they are not representative of cumulative noise levels for all active operations.

[27] i.e. 1000 m for mining noise impacts and 500 m for rail impacts, which is suitable for strategic assessment purposes.

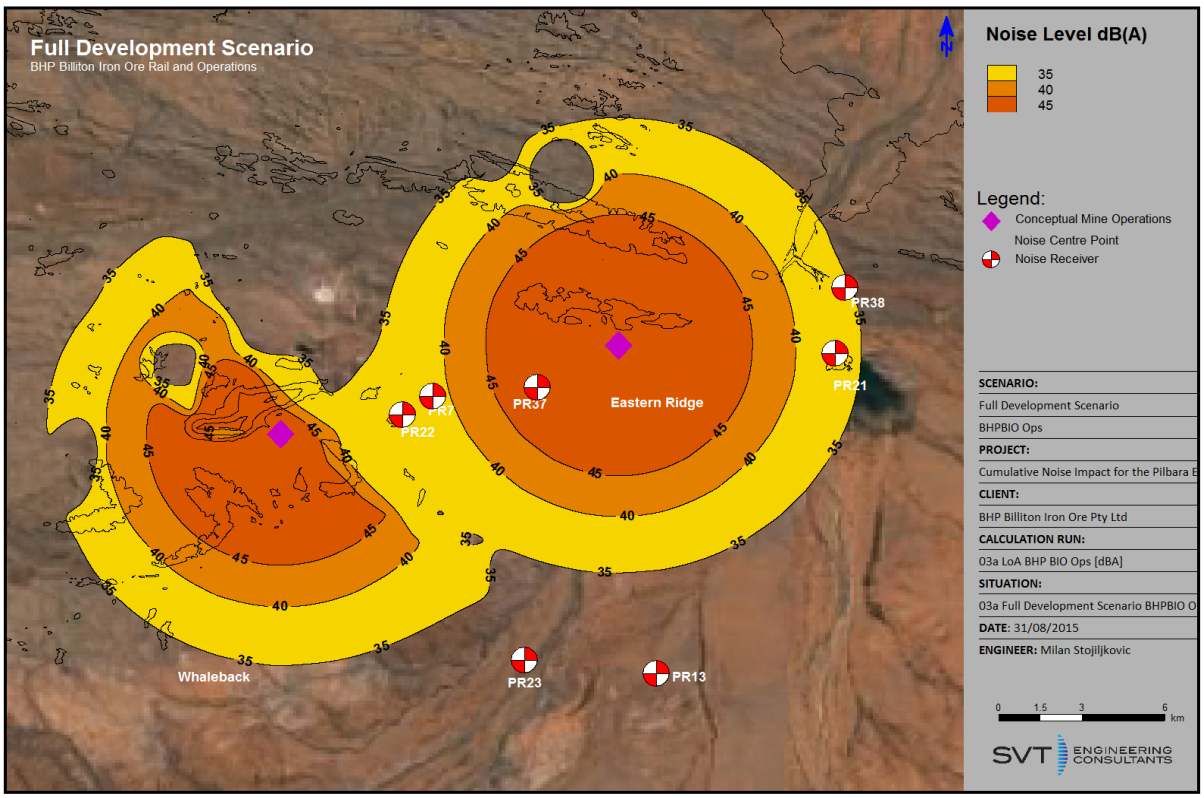


Figure 5-1 Noise contours depicting Newman operational hub and Eastern Ridge processing hub for the Full Development Scenario which yielded a potential noise criteria exceedance at the Newman Town Centre (PR07)

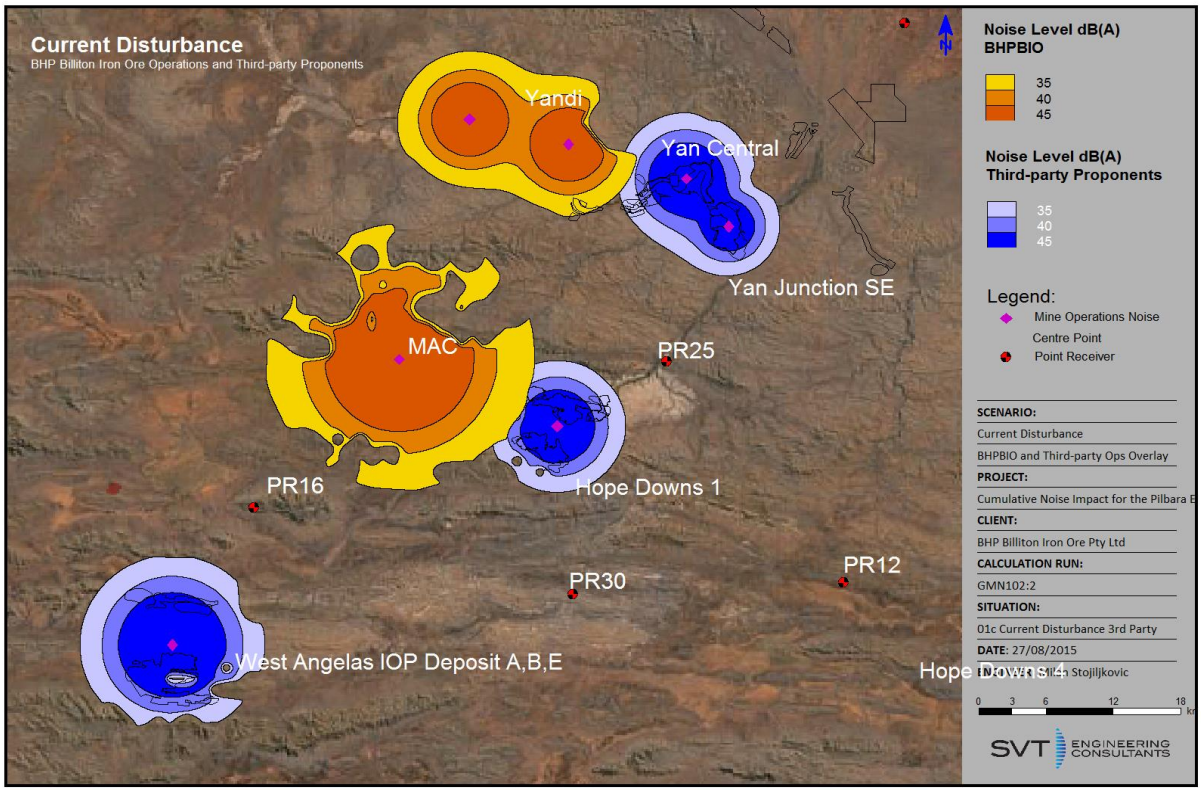


Figure 5-2 Overlay noise contours for the Current Disturbance scenario

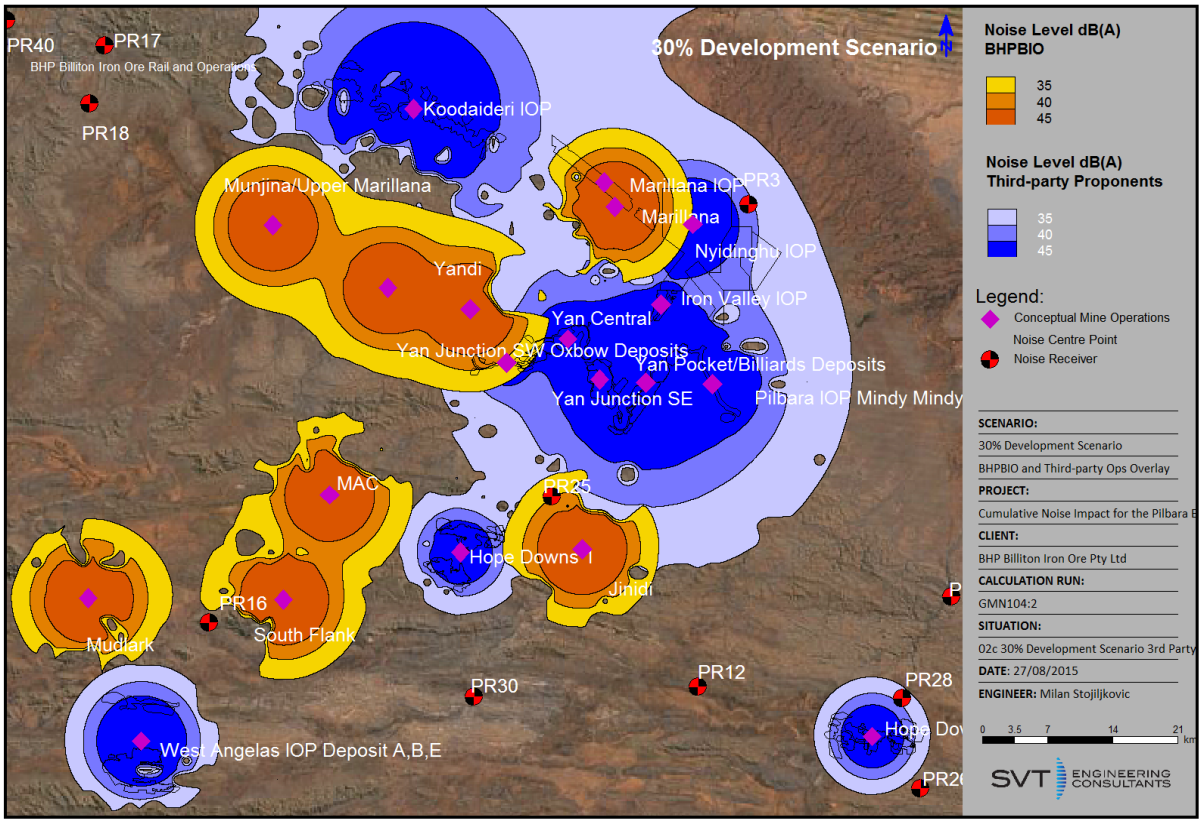


Figure 5-3 Overlay noise contours for the 30% Development Scenario

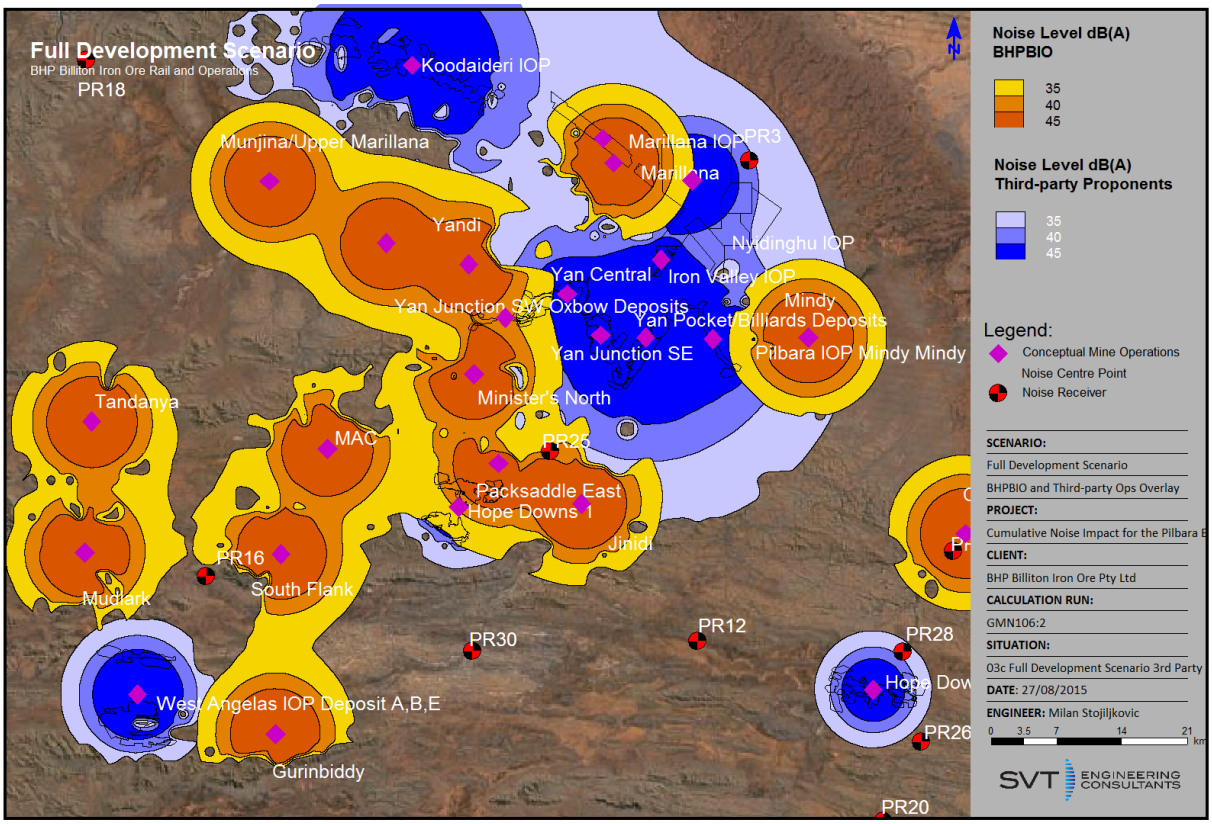


Figure 5-4 Overlay noise contours for the Full Development Scenario

6. CONCLUSIONS

Based on the cumulative noise model predictions for mining operations, it can be concluded that BHP Billiton Iron Ore mining operations do not exceed the noise limit criteria for the Current Disturbance Scenario.

For both the 30% Development Scenario and Full Development Scenario, the model predicts exceedance of the noise criteria at the Township of Newman (PR07) caused by BHP Billiton Iron Ore's mining activities. Based on these predictions, it is recommended that BHP Billiton Iron Ore focus their future noise control efforts on mining activities affecting the Township of Newman.

All other noise sensitive receiver locations were compliant with the noise criteria, except at Marillana Homestead (PR03) where the exceedance was caused by a third-party proponent.

Noise sensitive receivers were also assessed for transportation noise impacts from BHP Billiton Iron Ore operated rail network. Model predictions indicate that rail noise impacts will not result in high received noise levels, with all assessed locations being compliant with the rail noise criteria.

7. REFERENCES

1. BHP Billiton Iron Ore Memorandum to SEA consultants, 24 June 2014.
2. Environmental Noise Assessment for MAC Expansions – P1W and P1E Gate 2A, SVT Rep. No. 1253826-Rev1-20 August 2012.
3. Orebody 24 Mine Modification Environmental Noise Assessment, SVT Rep. No. 1153352-1-100-Rev3-12 September 2011.

APPENDIX A NOISE CONTOURS FOR CURRENT DISTURBANCE SNAPSHOT

Noise contours which show cumulative noise impacts from BHP Billiton Iron Ore operations are presented with filled contours for both mining and rail noise impacts (Figure A-1).

Noise contour overlays which show the BHP Billiton Iron Ore mining and rail noise impacts separately are presented with filled contours for rail impacts and line contours for mining impacts (Figures A-2 and A-3).

Third-party proponent noise impacts are presented with line contours (Figures A-4 and A-5).

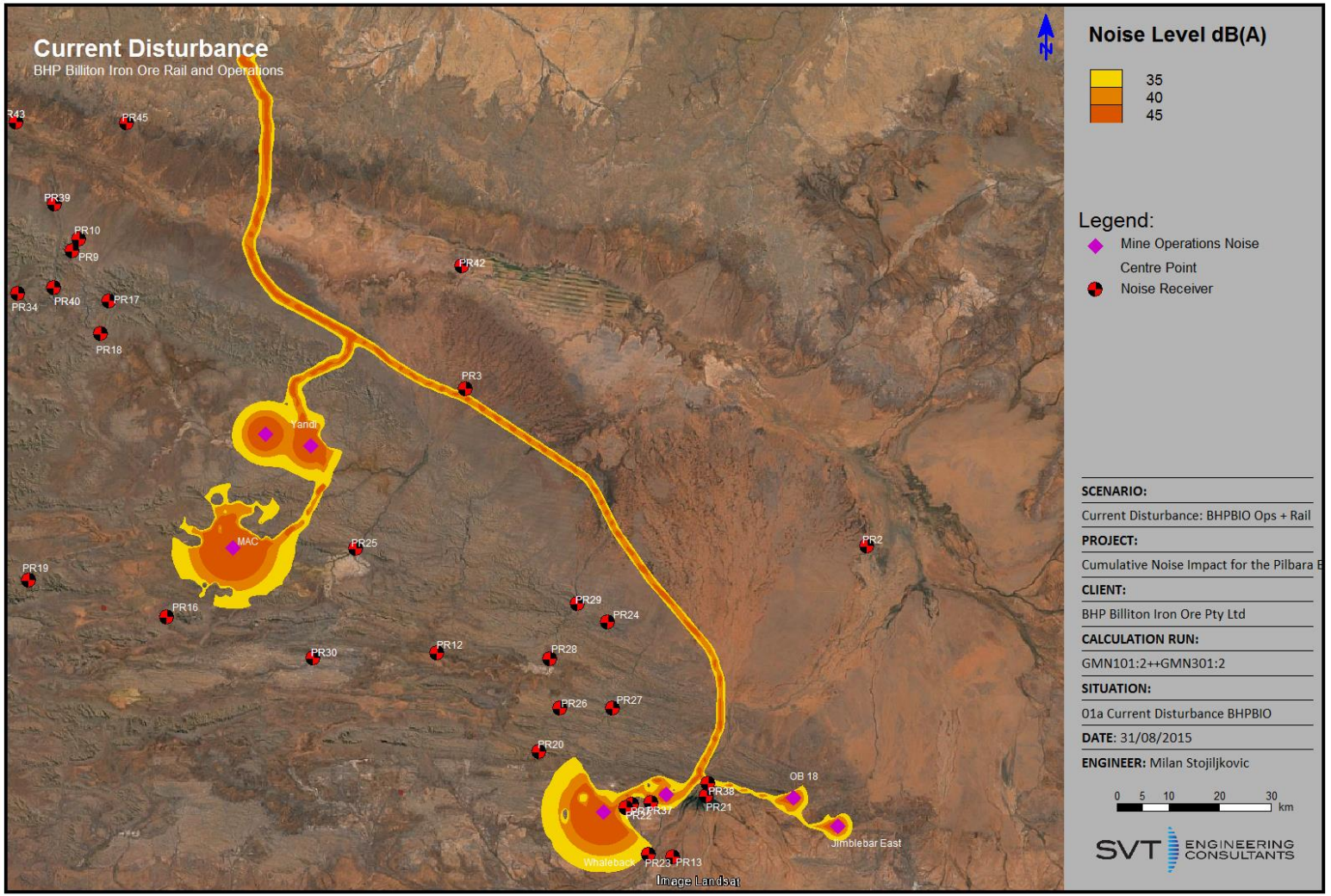


Figure A-1 A-weighted noise contours for Current Disturbance Snapshot – Cumulative noise impacts from BHP Billiton Iron Ore Operations and Rail

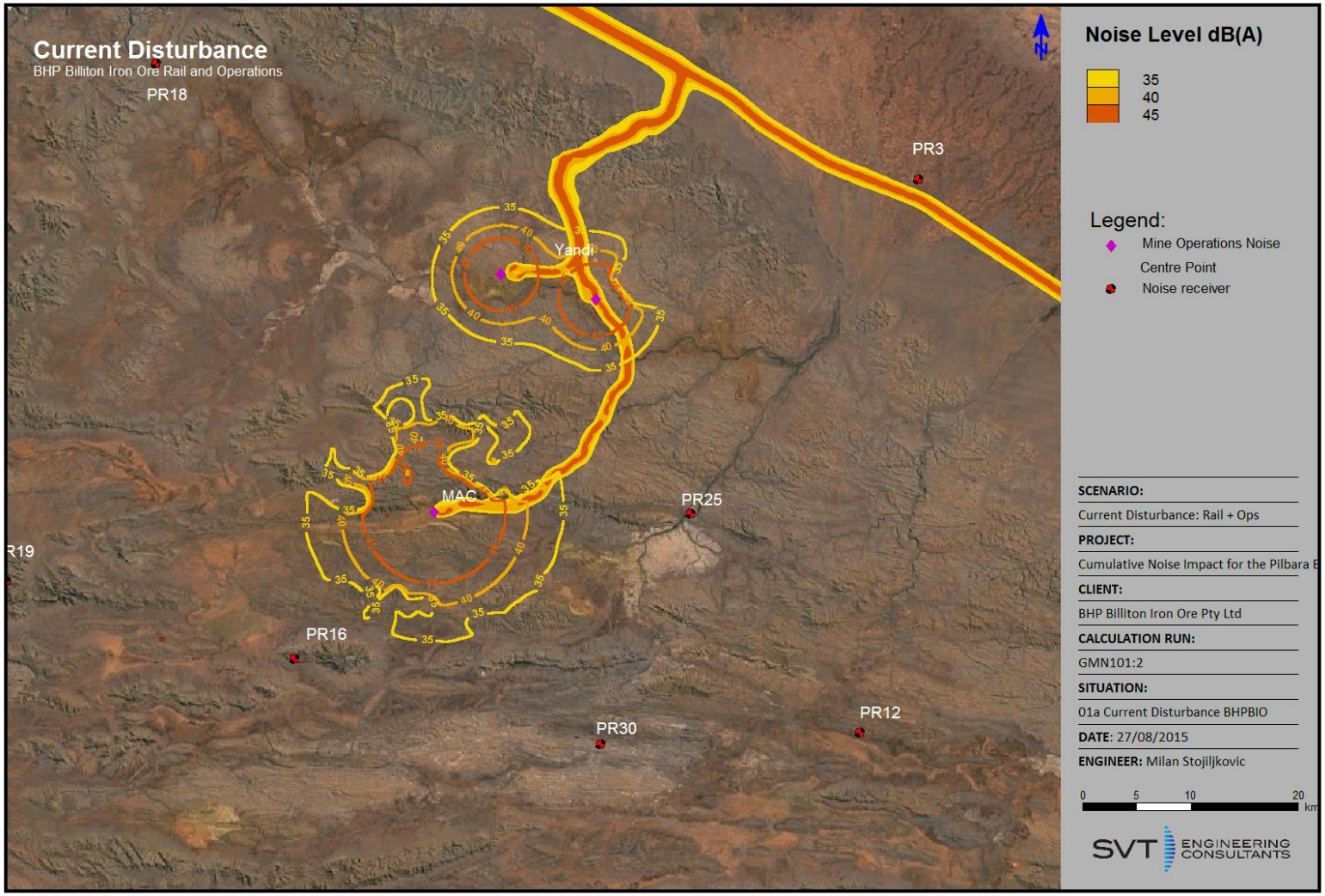


Figure A-2 A-weighted noise contours for Current Disturbance Snapshot - BHP Billiton Iron Ore Operations (line contours) and Rail (filled contours) – MAC and Yandi Hubs

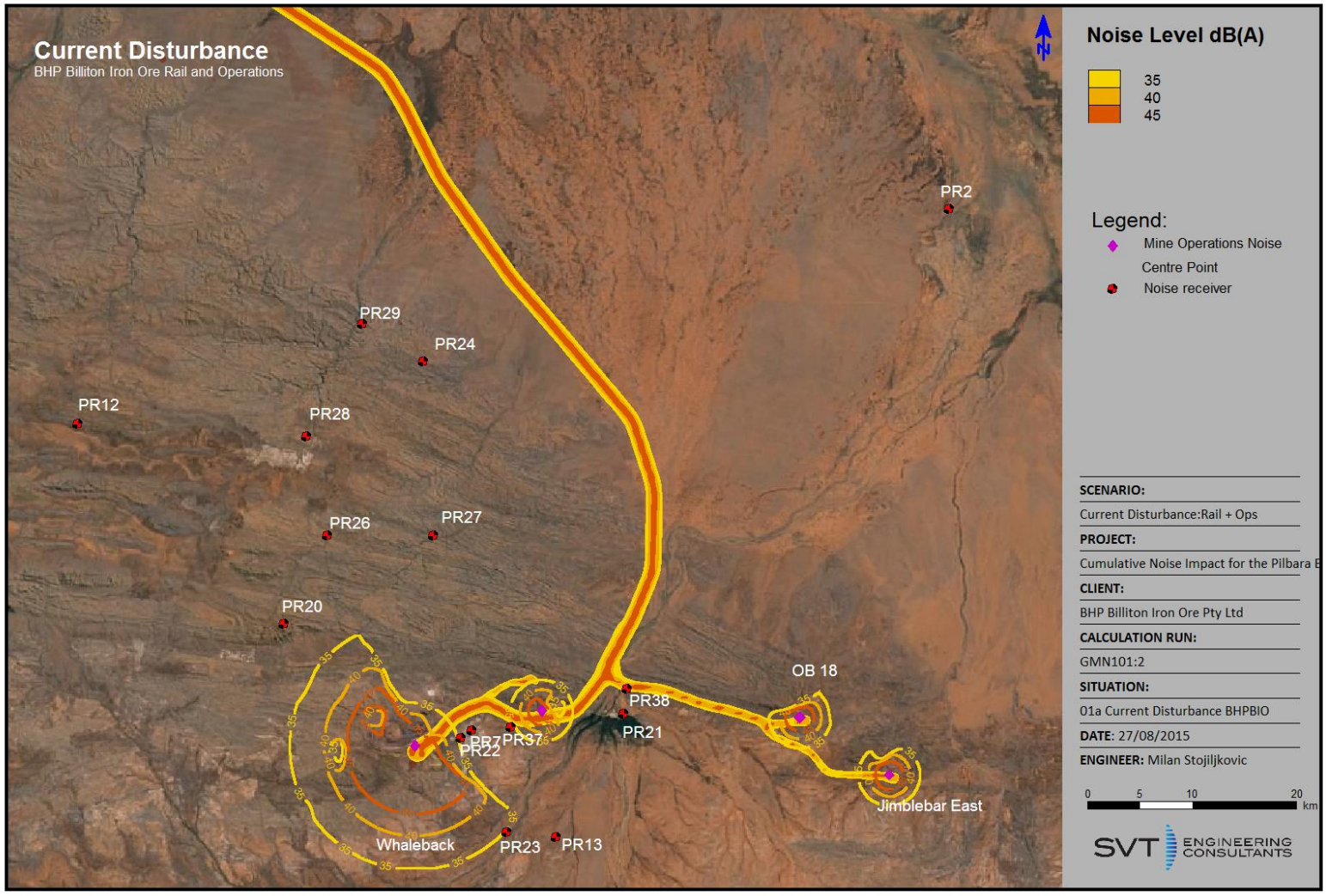


Figure A-3 A-weighted noise contours for Current Disturbance Snapshot - BHP Billiton Iron Ore Operations (line contours) and Rail (filled contours) –Whaleback & Jimblebar Hubs

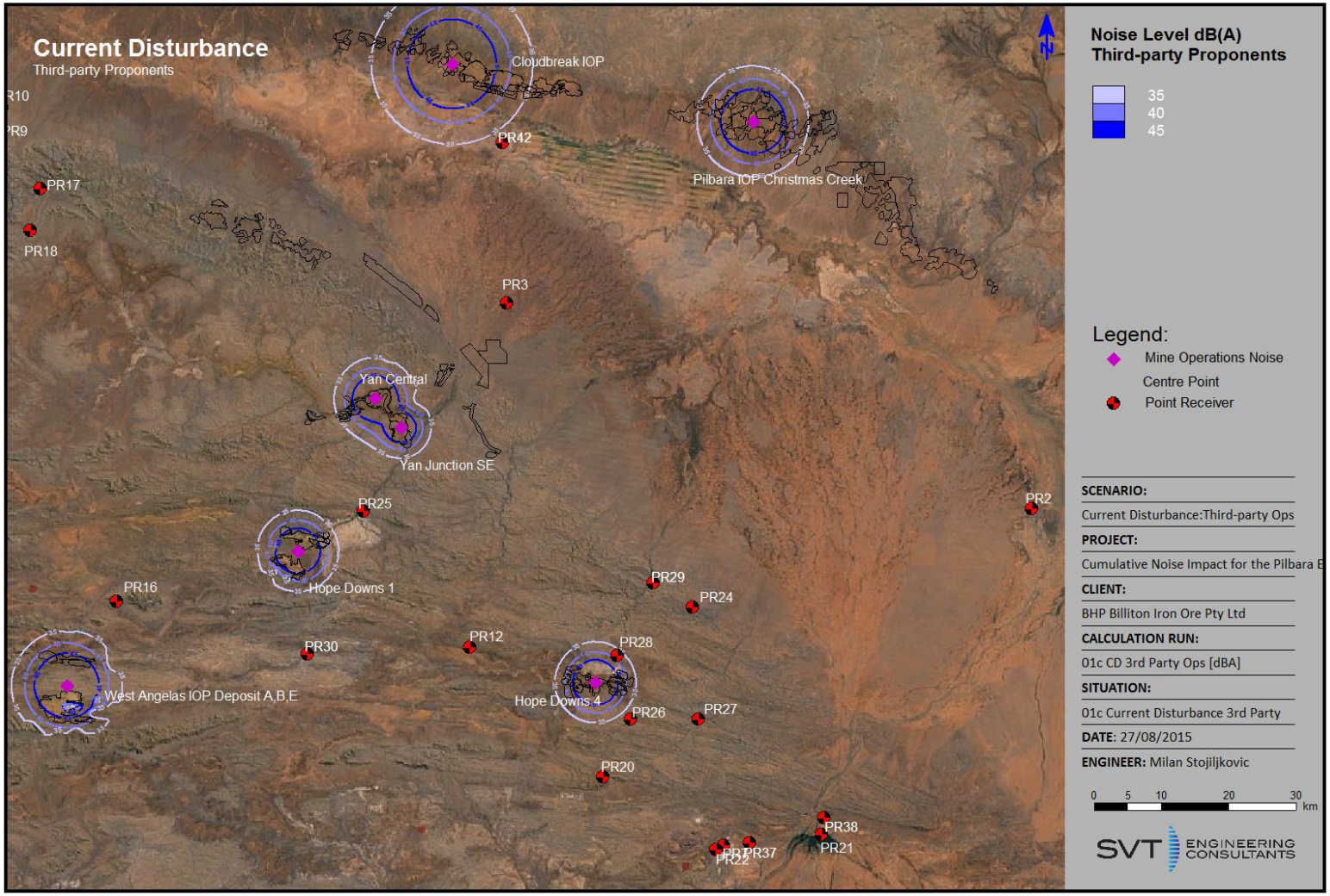


Figure A-4 A-weighted noise contours for Current Disturbance Snapshot – Third-party Proponent Operations – Eastern Section

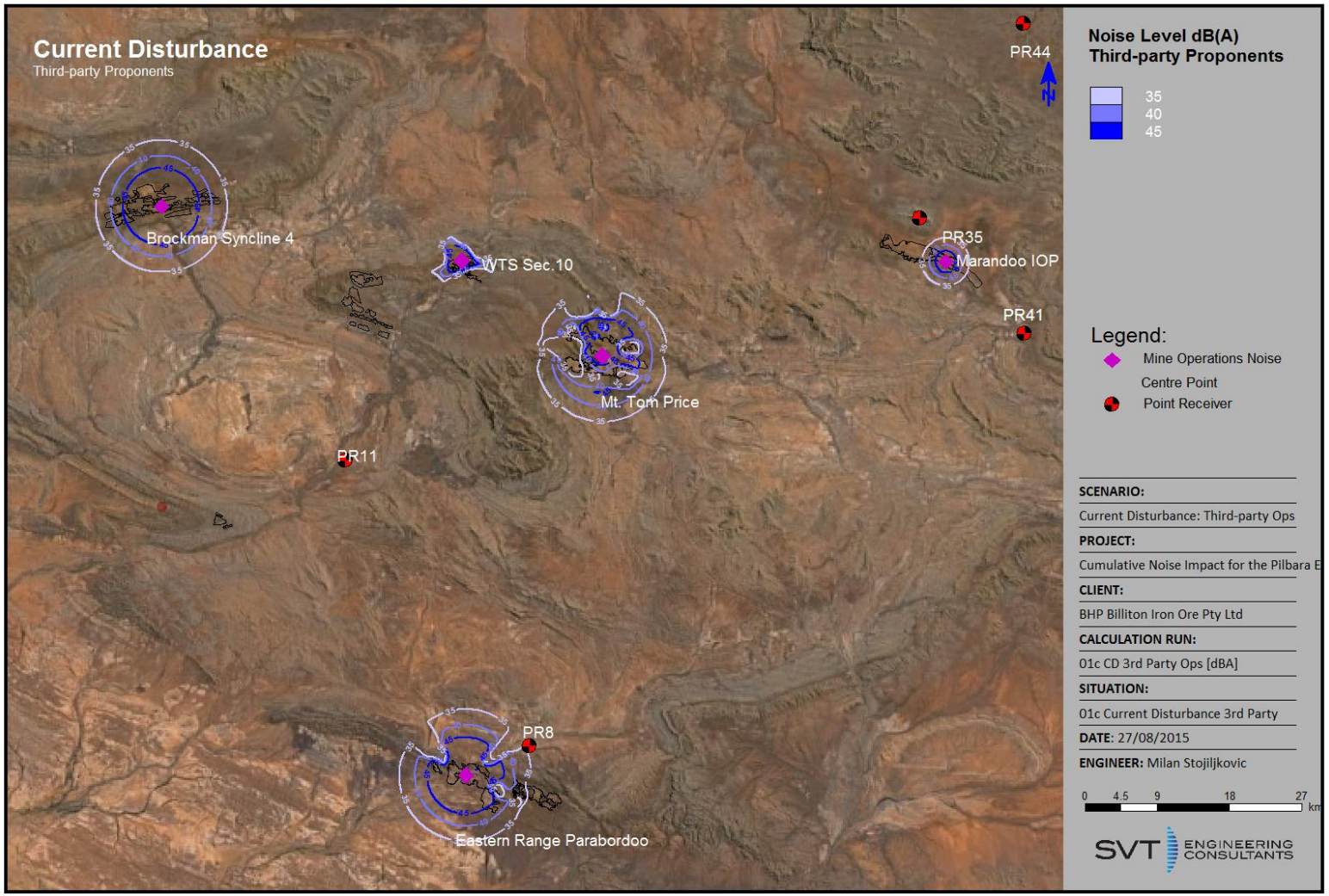


Figure A-5 A-weighted noise contours for Current Disturbance Snapshot – Third-party Proponent Operations – Western Section

APPENDIX B NOISE CONTOURS FOR 30% DEVELOPMENT SCENARIO

Noise contours which show cumulative noise impacts from BHP Billiton Iron Ore operations are presented with filled contours for both mining and rail noise impacts (Figure B-1).

Noise contour overlays which show the BHP Billiton Iron Ore mining and rail noise impacts separately are presented with filled contours for rail impacts and line contours for mining impacts (Figures B-2 and B-3).

Third-party proponent noise impacts are presented with line contours (Figures B-4 and B-5).

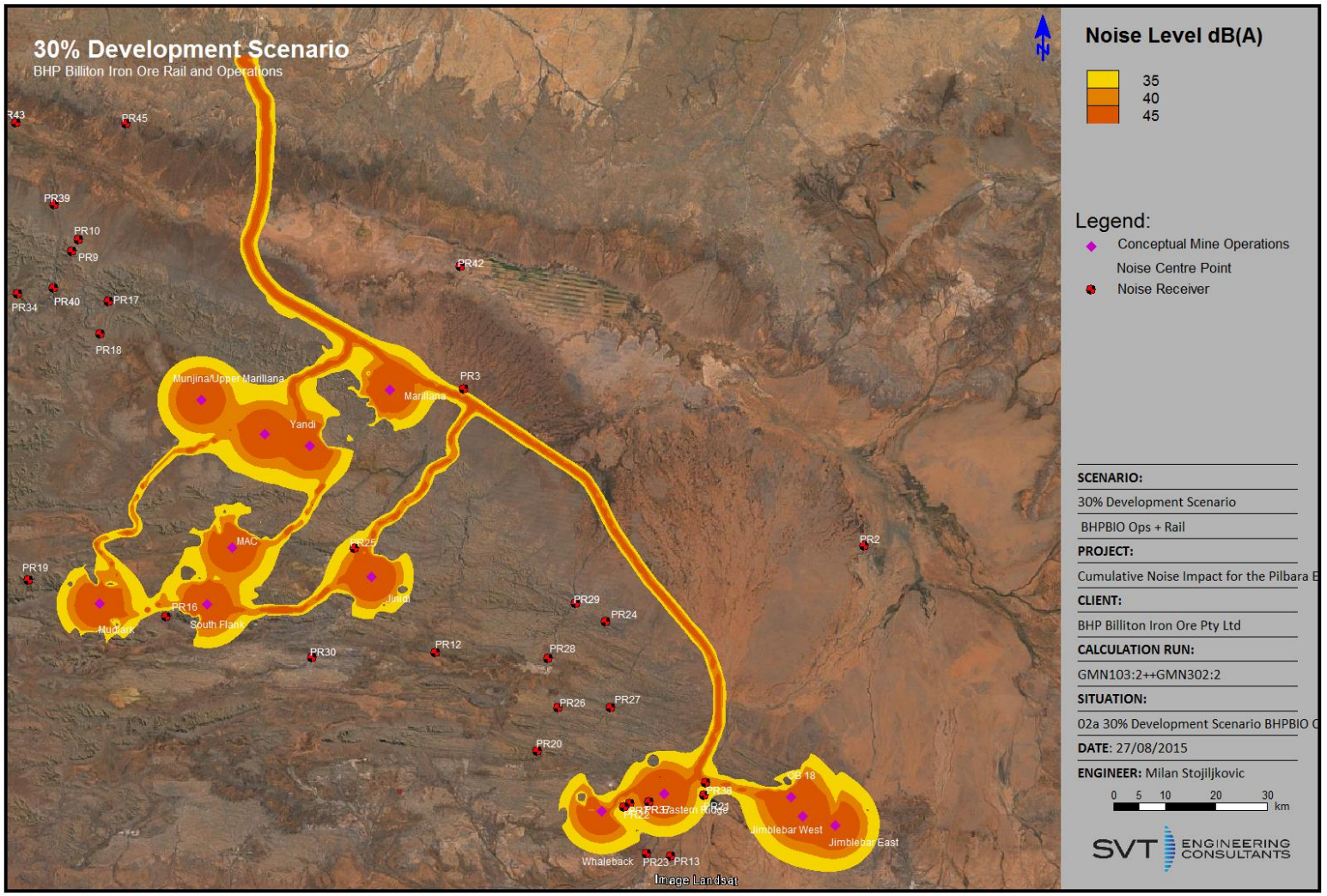


Figure B-1 A-weighted noise contours for the 30% Development Scenario - Cumulative noise impacts from BHP Billiton Iron Ore Operations and Rail

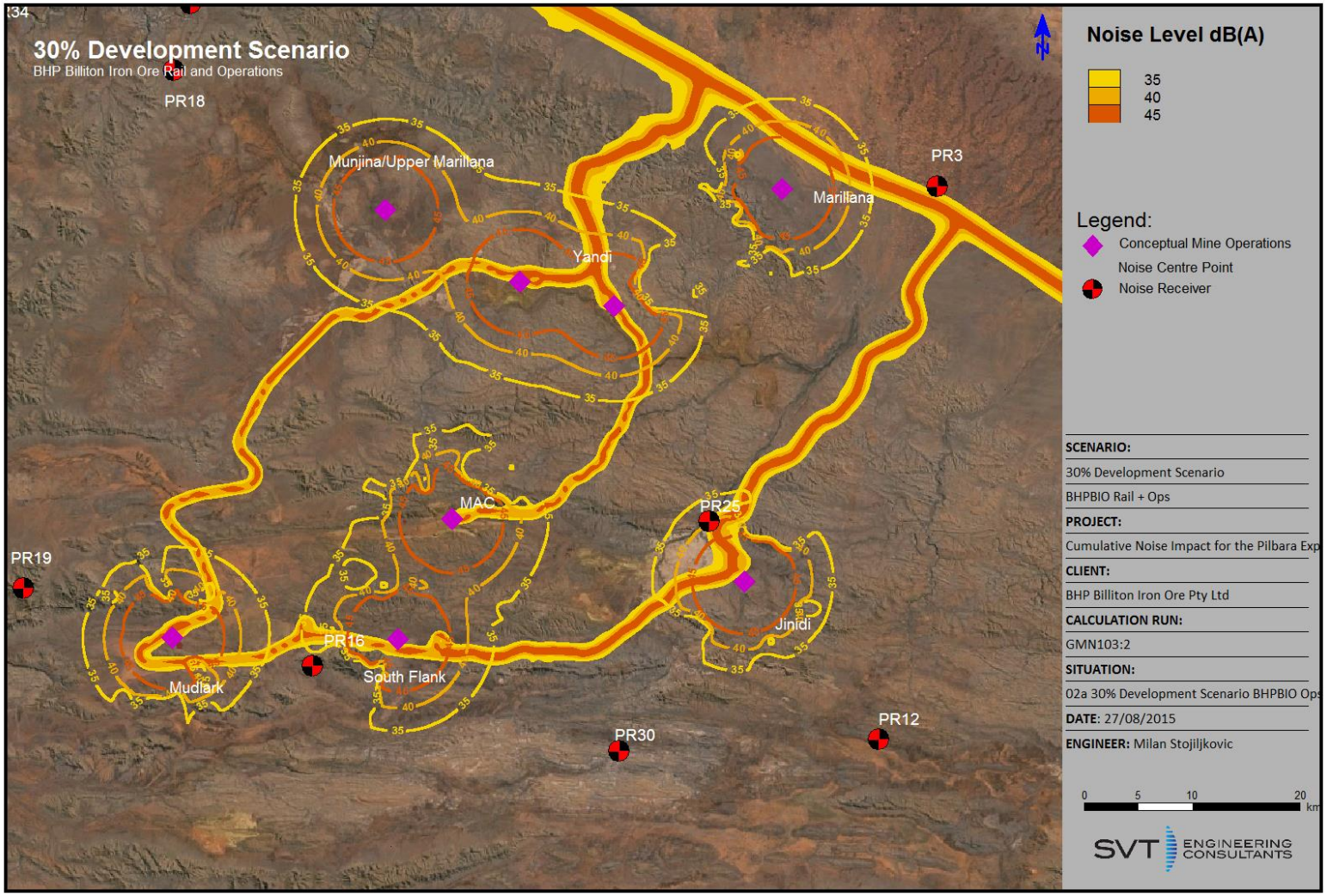


Figure B-2 A-weighted noise contours for the 30% Development Scenario - BHP Billiton Iron Ore Operations (line contours) and Rail (filled contours) – MAC and Yandi Hubs including proposed hubs and expansions

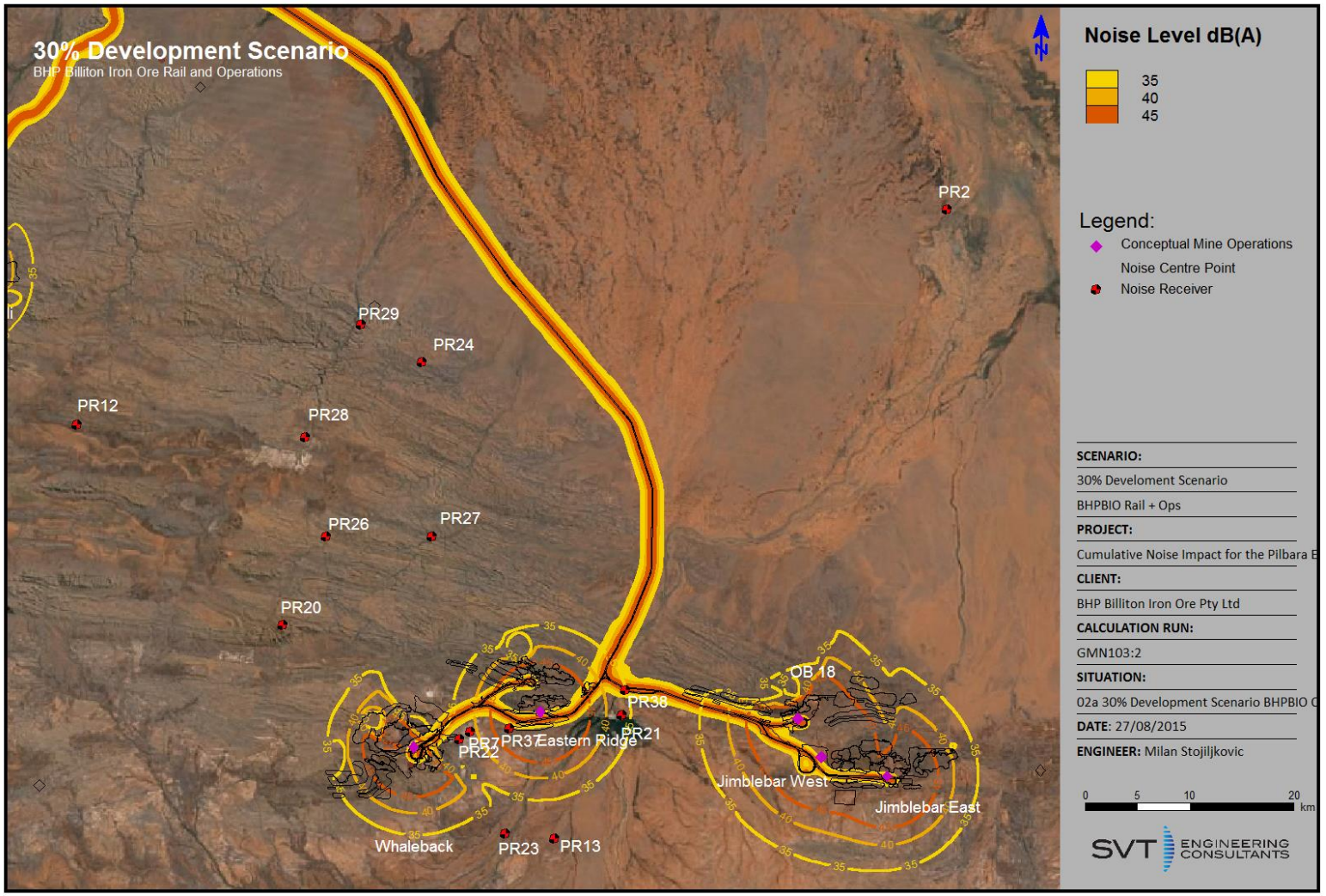


Figure B-3 A-weighted noise contours for the 30% Development Scenario - BHP Billiton Iron Ore Operations (line contours) and Rail (filled contours) – Whaleback and Jimblebar Hubs including proposed hubs and expansions

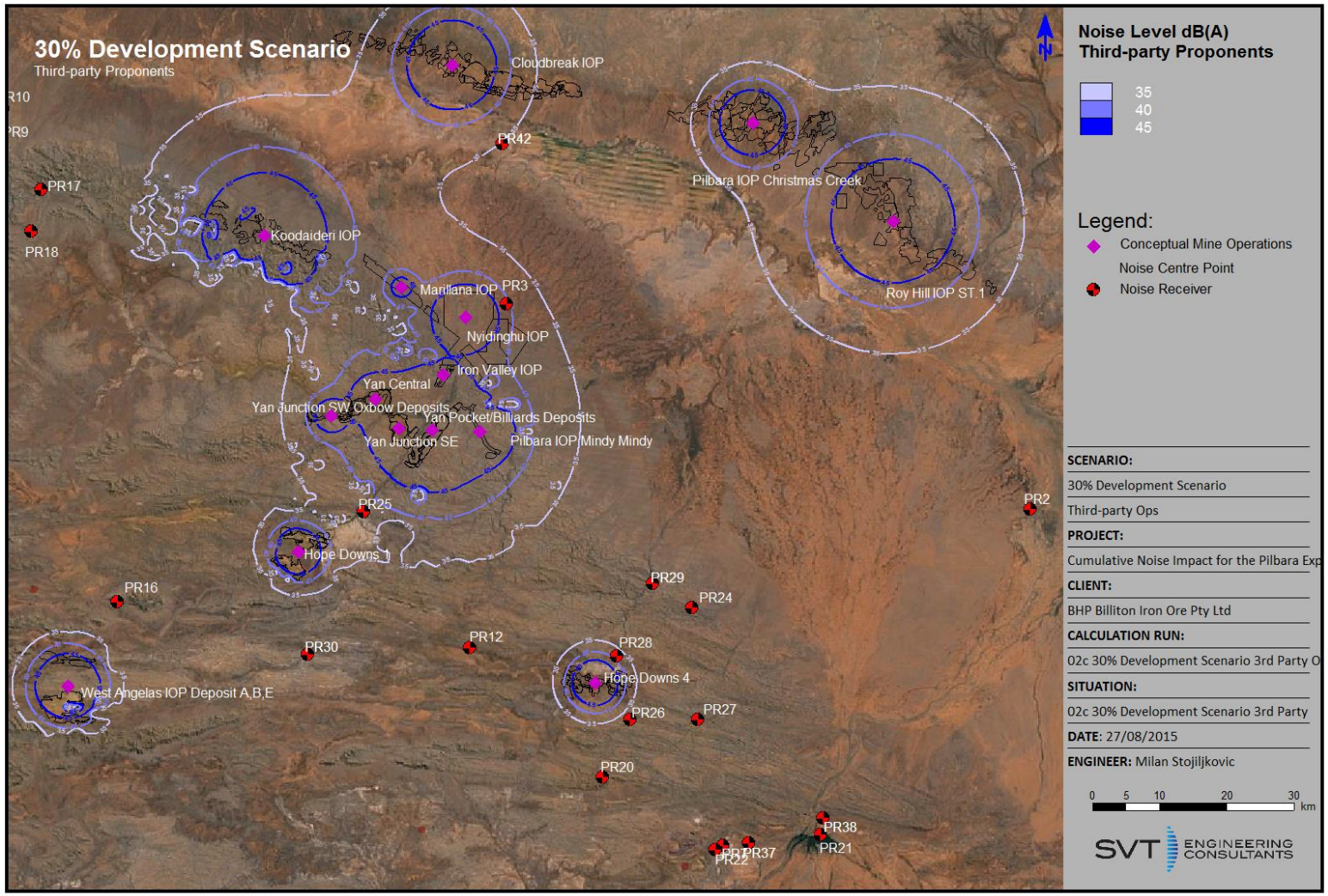


Figure B-4 A-weighted noise contours for the 30% Development Scenario – Third-party Proponent Operations – Eastern Section

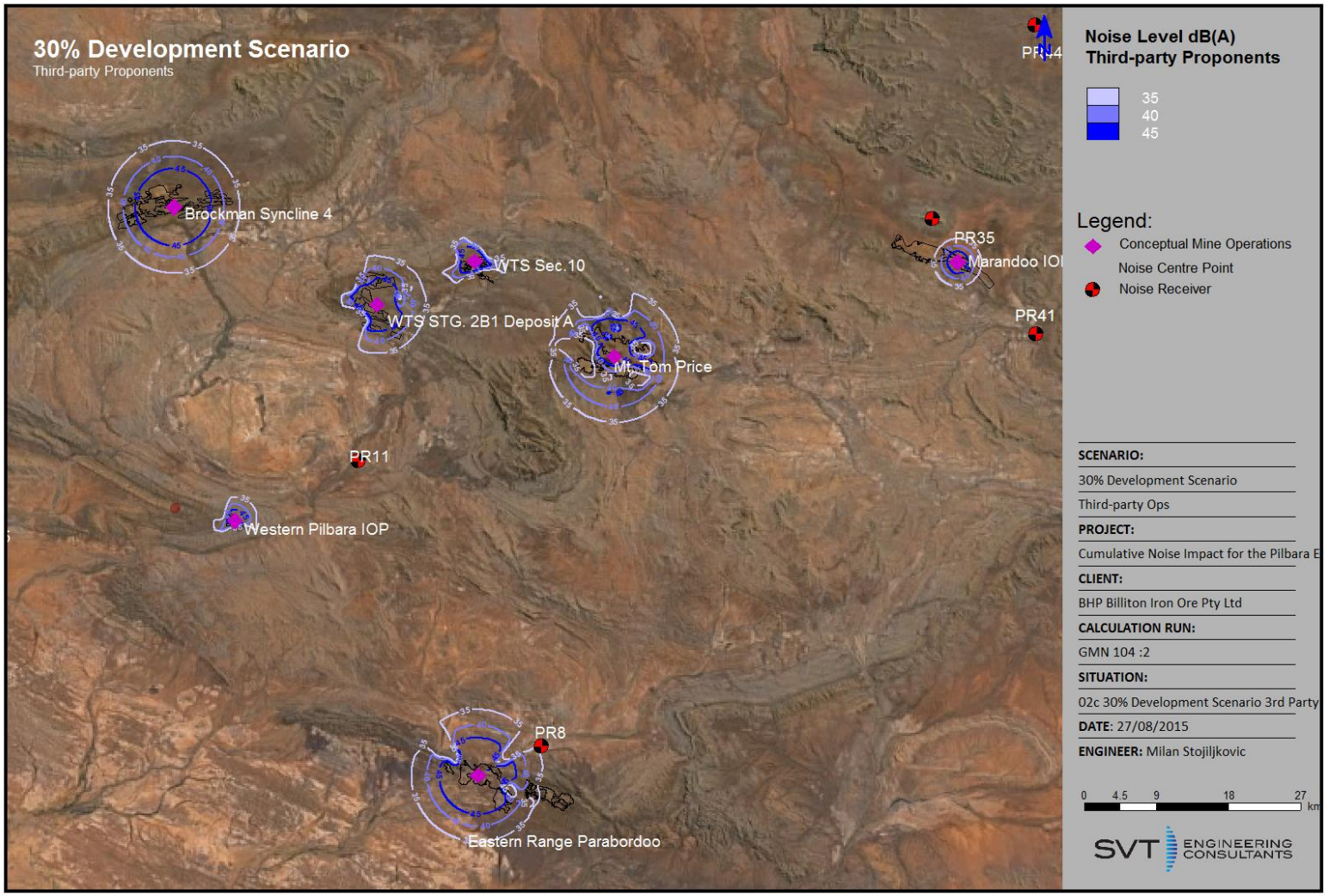


Figure B-5 A-weighted noise contours for the 30% Development Scenario – Third-party Proponent Operations – Western Section

APPENDIX C NOISE CONTOURS FOR FULL DEVELOPMENT SCENARIO

Noise contours which show cumulative noise impacts from BHP Billiton Iron Ore operations are presented with filled contours for both mining and rail noise impacts (Figure C-1).

Noise contour overlays which show the BHP Billiton Iron Ore mining and rail noise impacts separately are presented with filled contours for rail impacts and line contours for mining impacts (Figures C-2 and C-3).

Third-party proponent noise impacts are presented with line contours (Figures C-4 and C-5).

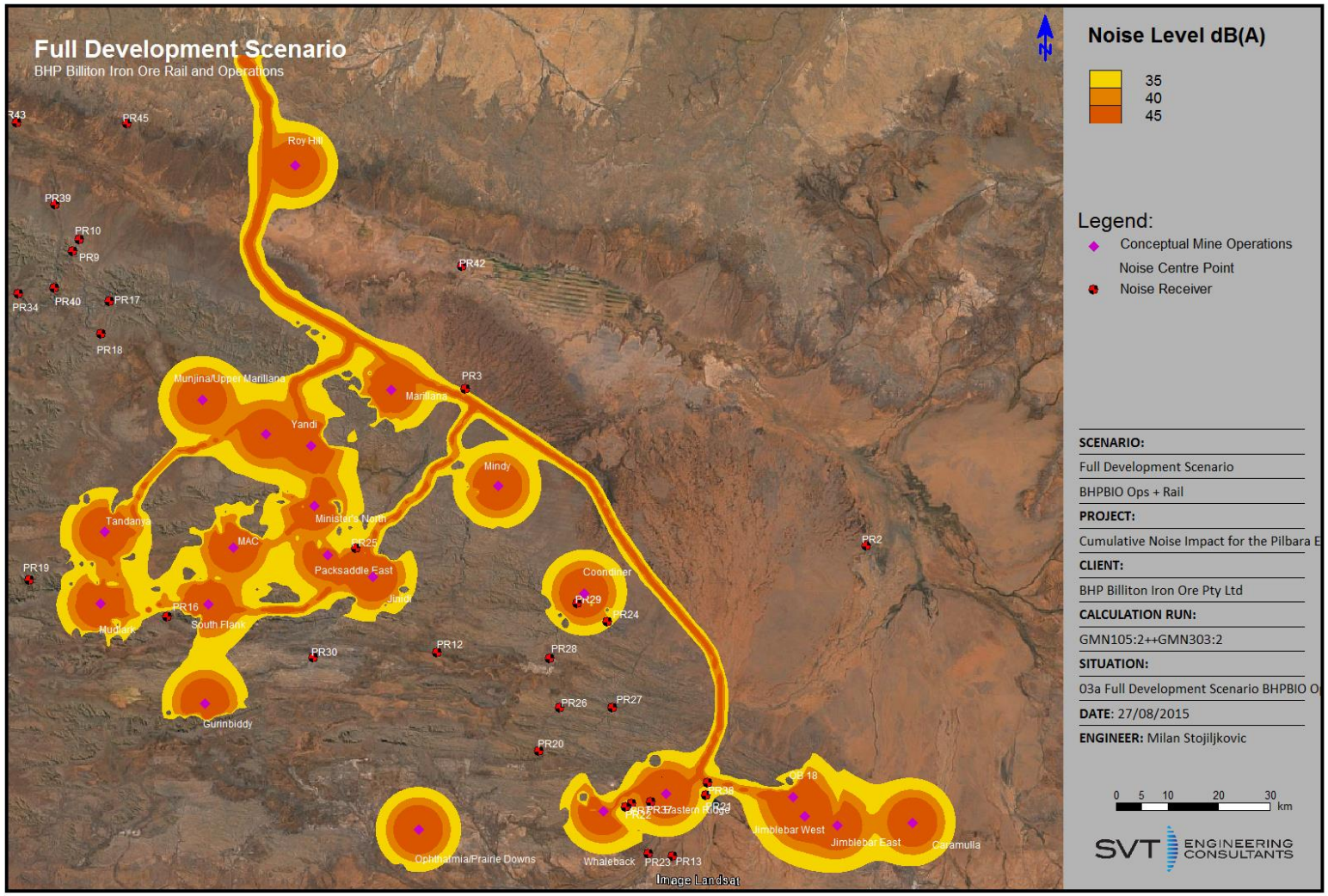


Figure C-1 A-weighted noise contours for the Full Development Scenario – Cumulative noise impacts from BHP Billiton Iron Ore Operations and Rail

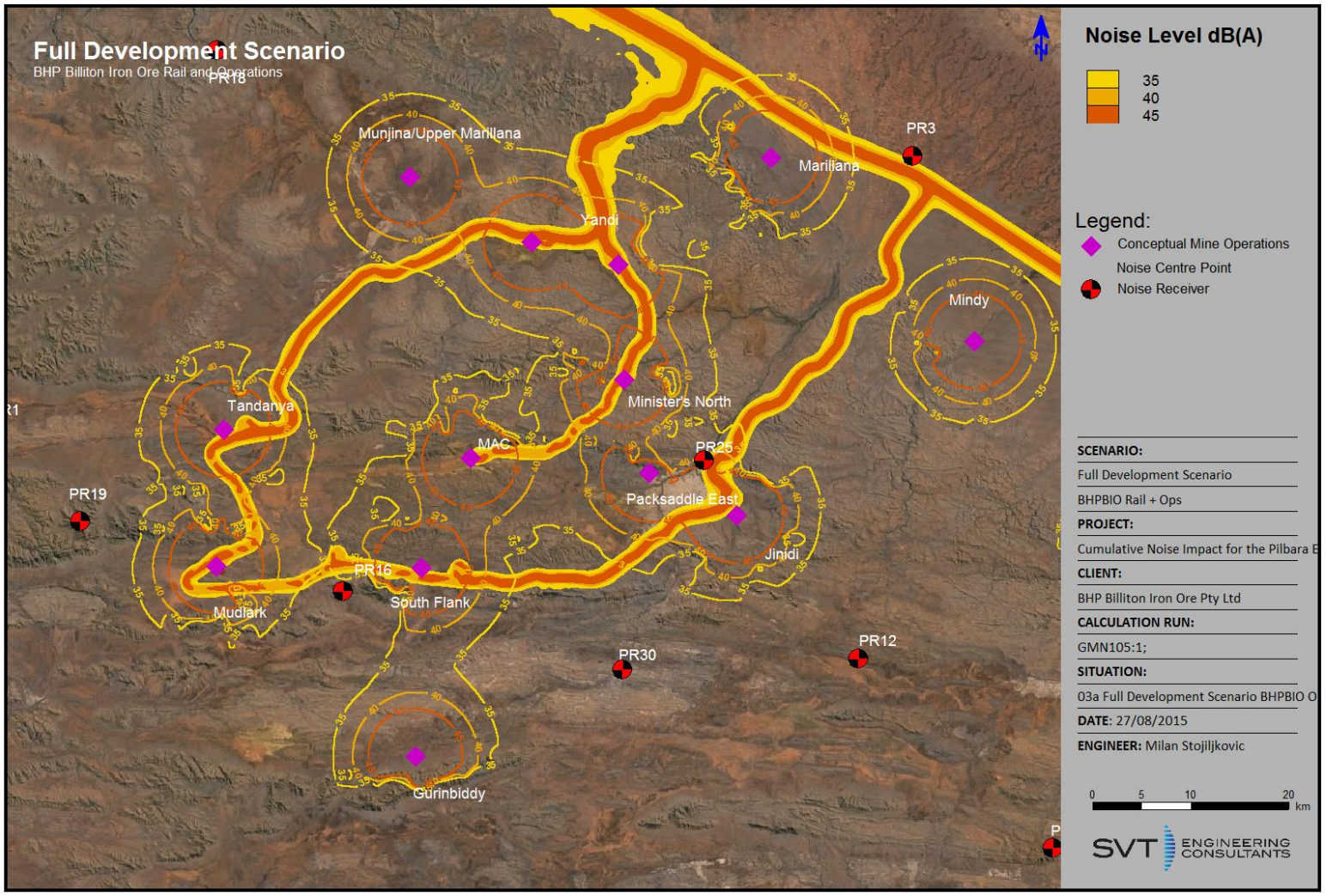


Figure C-2 A-weighted noise contours for the Full Development Scenario - BHP Billiton Iron Ore Operations (line contours) and Rail (filled contours) – MAC and Yandi Hubs including proposed hubs and expansions

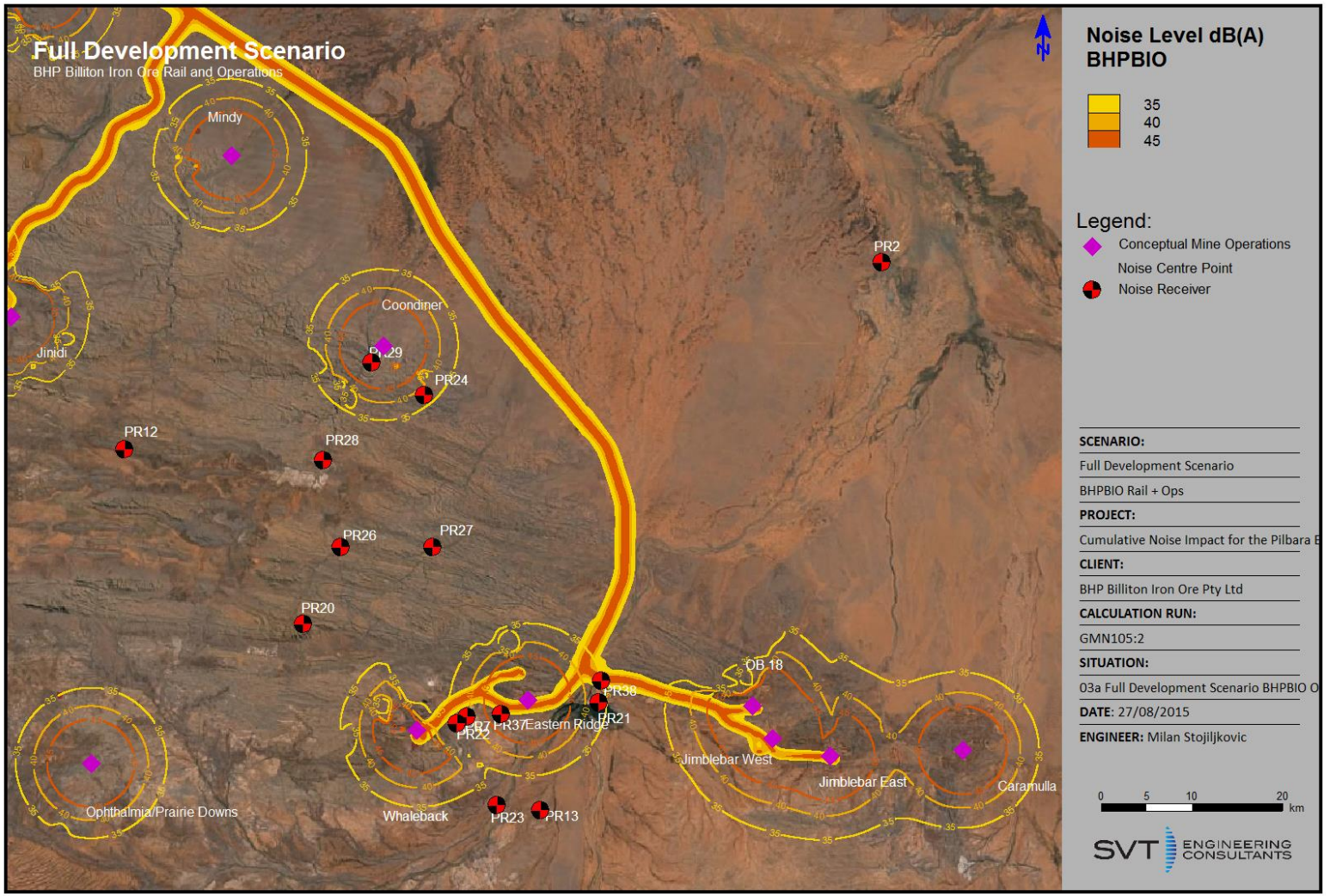


Figure C-3 A-weighted noise contours for the Full Development Scenario - BHP Billiton Iron Ore Operations (line contours) and Rail (filled contours) – Whaleback and Jimblebar Hubs including future hubs and expansions

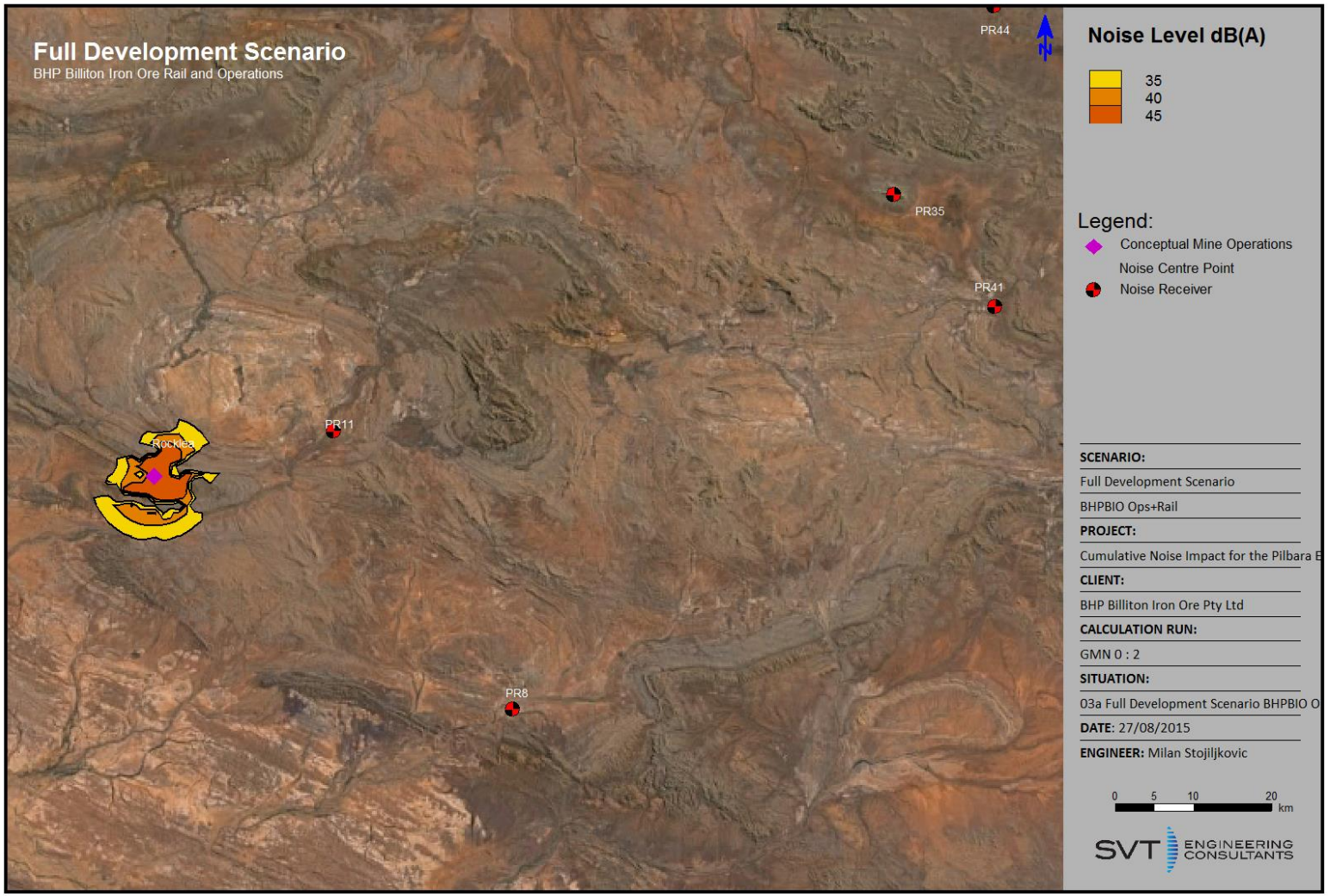


Figure C-4 A-weighted noise contours for the Full Development Scenario - BHP Billiton Iron Ore Operations (line contours) and Rail (filled contours) – Rocklea Hub

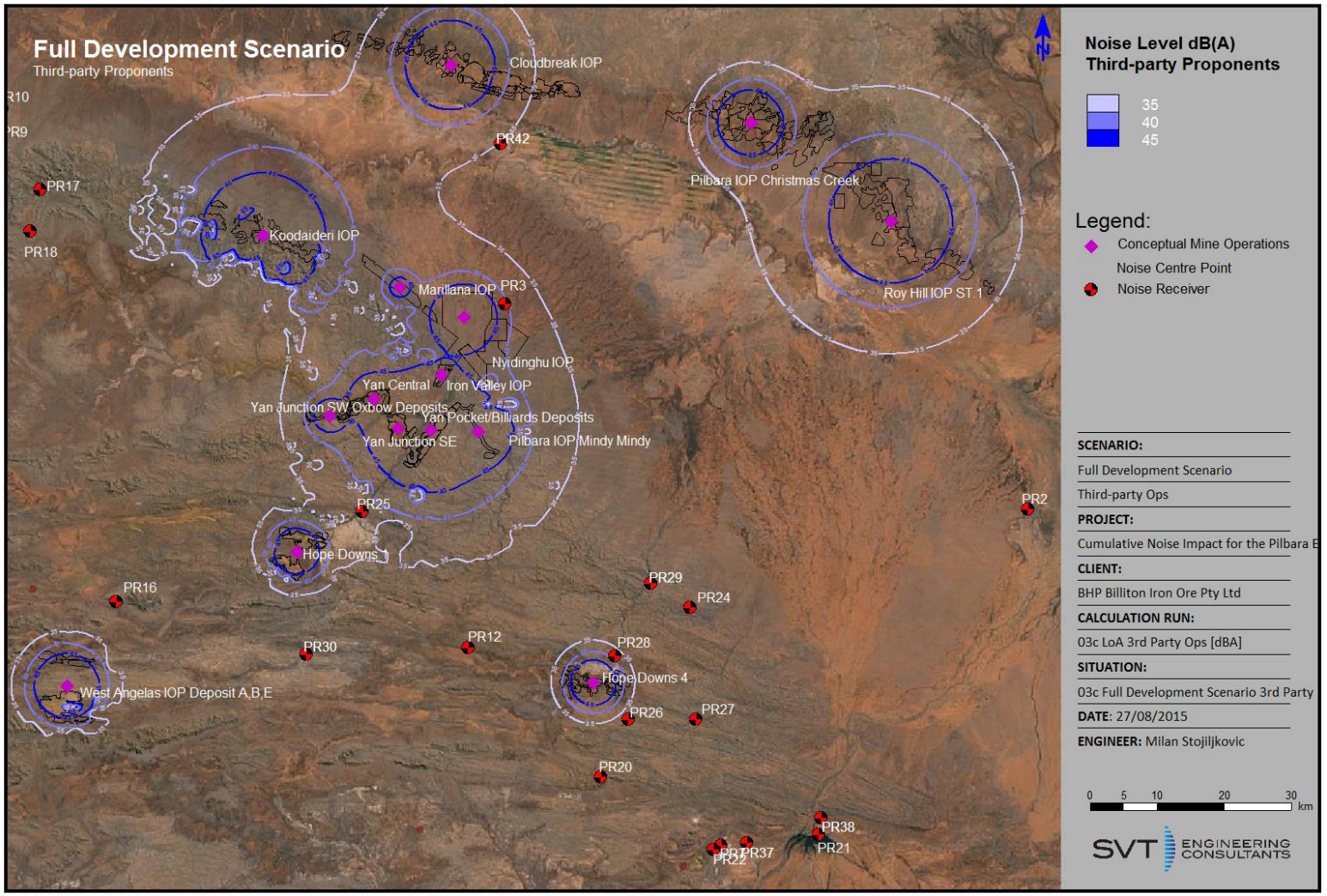


Figure C-5 A-weighted noise contours for the Full Development Scenario – Third-party Proponent Operations – Eastern Section

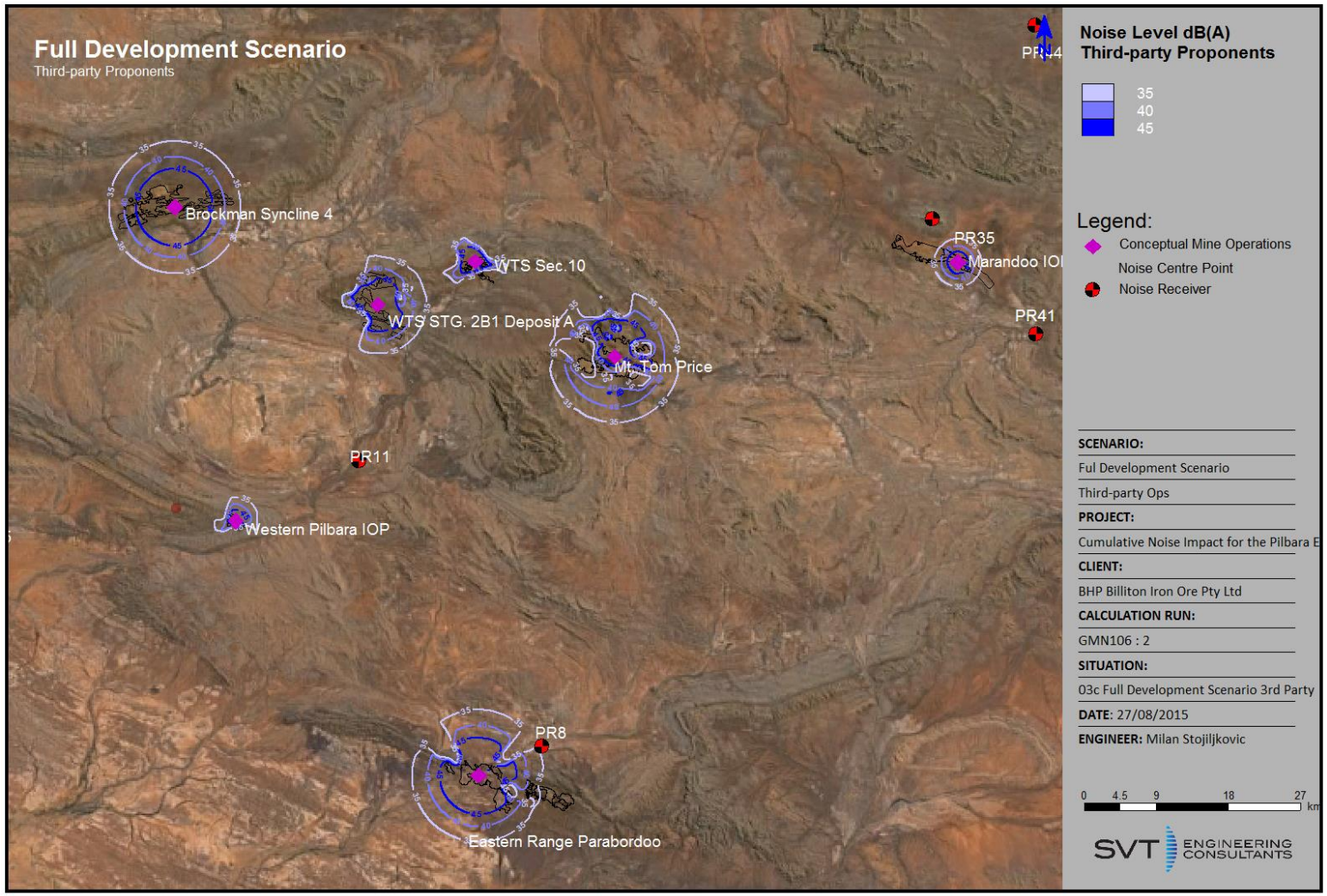


Figure C-6 A-weighted noise contours for the Full Development Scenario – Third-party Proponent Operations – Western Section

APPENDIX D OVERLAY NOISE CONTOURS FOR BHP BILLITON IRON ORE AND THIRD PARTY MINING OPERATIONS

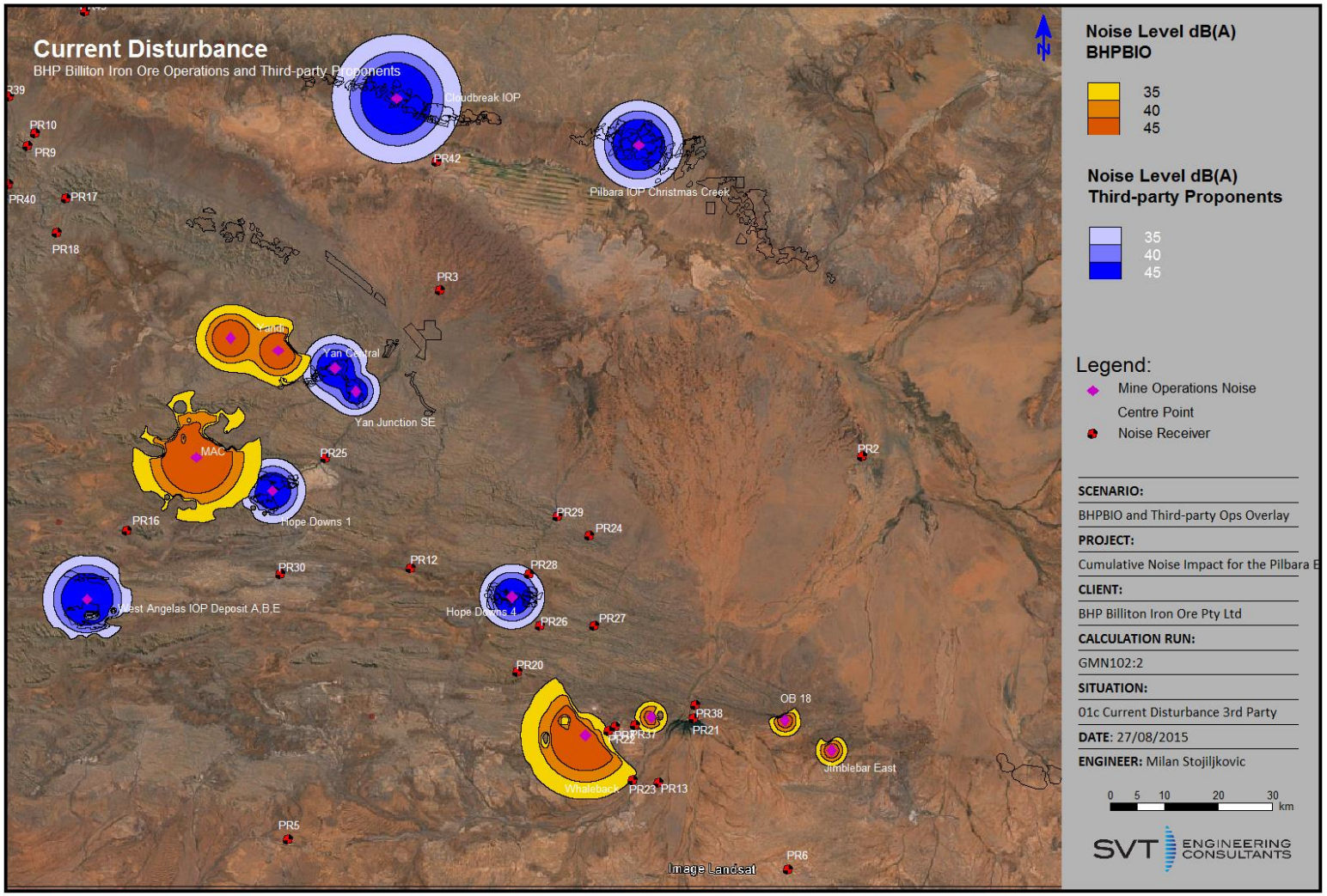


Figure D-1 Overlay noise contours for the Current Disturbance scenario

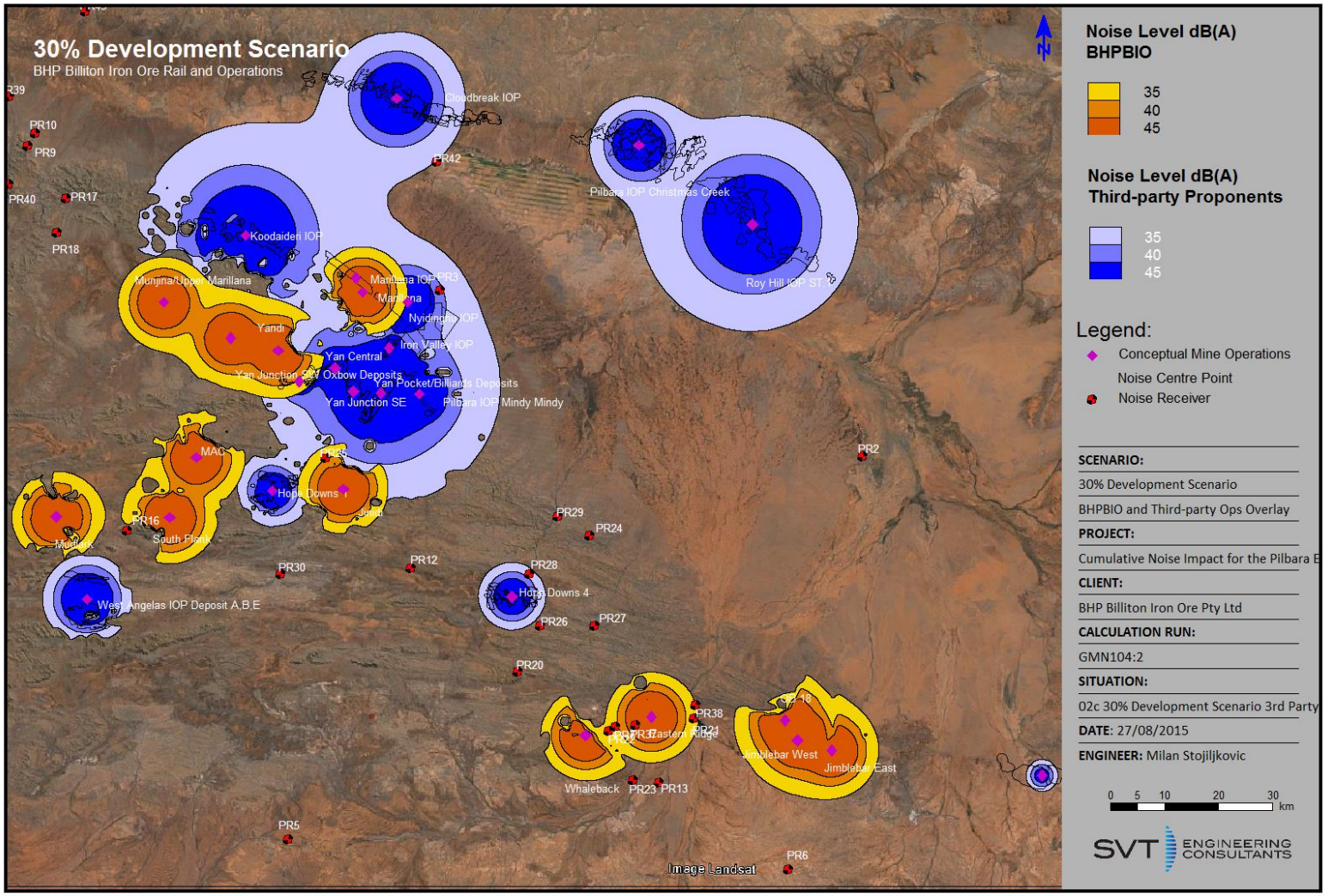


Figure D-2 Overlay noise contours for the 30% Development Scenario

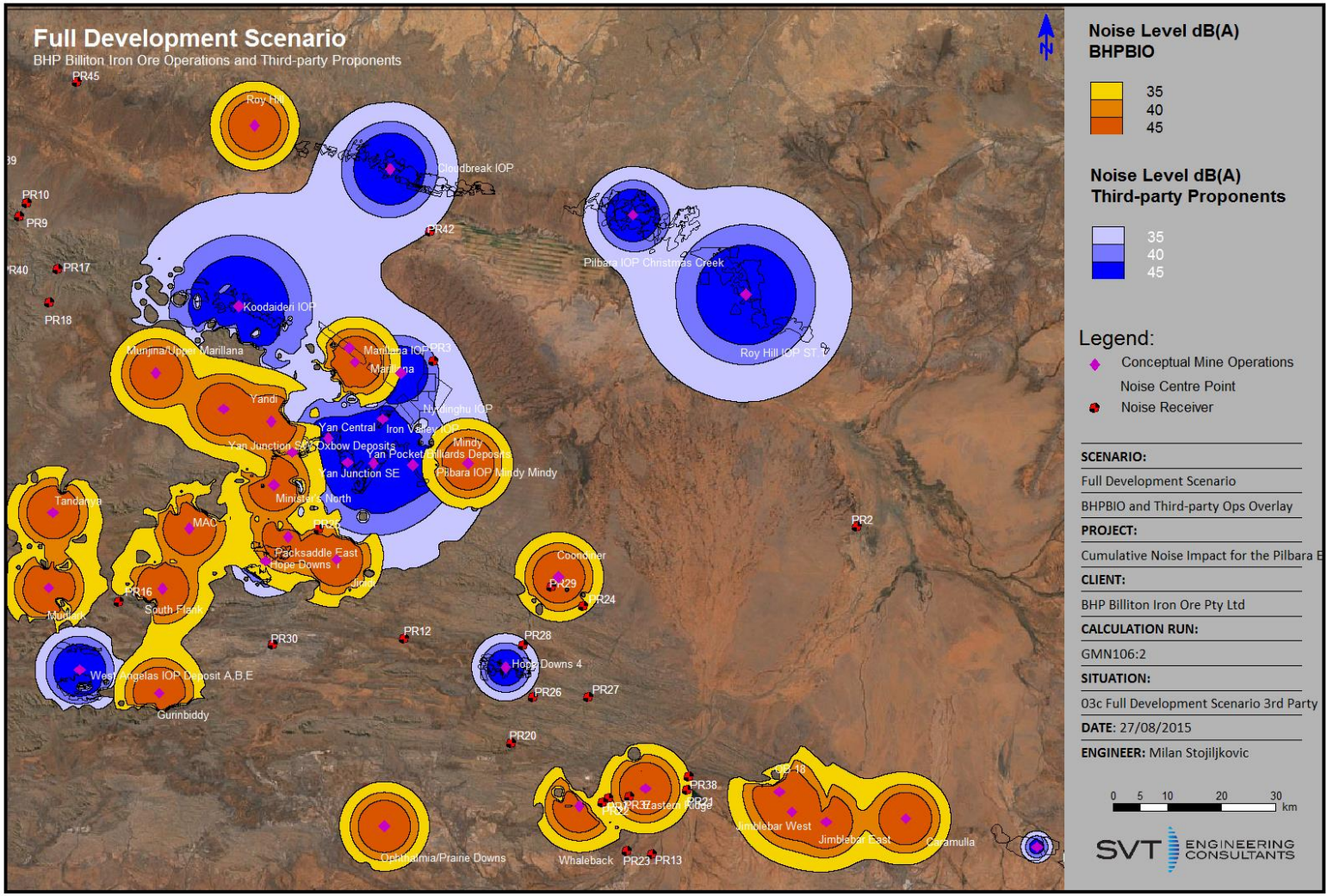


Figure D-3 Overlay contours for the Full Development Scenario

APPENDIX E PROCESSING HUB AND POINT RECEIVER LOCATIONS

Table E-1 BHP Billiton Iron Ore processing hub locations

Processing Hub	Site Location (Easting z50)	Site Location (Northing z50)
Mining Area C	702445.08	7464261.15
Yandi West	708725.6	7486260.27
Yandi East	717523.29	7483977.76
Whaleback	774269.98	7412948.6
Eastern Ridge	786448.75	7416246.89
Orebody 18	811177.42	7415629.06
Jimblebar East	819752.57	7410094.91
Roy Hill	714469.06	7538601.57
Rocklea	522825.21	7463700.72
Tandanya	677331.76	7467219.48
Mudlark	676539.49	7453243.81
South Flank	697477.5	7453083.07
Ophthalmia / Prairie Downs	738367.15	7409240.37
Gurinbiddy	696895.82	7433872.72
Mindy	753782.07	7476182.66
Marillana	733037.96	7494858.55
Coondiner	770539.07	7455264.67
Carramulla	834430.85	7410681.69
Minister's North	718087.17	7472314.99
Jinidi	729554.26	7458435
Munijna / Upper Marillana	696314.07	7492888.94
Packsaddle East	720706.34	7462726.66
Jimblebar West	813438.42	7411979.91

Table E-2 Third-party proponents operational hub locations

Processing Hub	Site Location (Easting z50)	Site Location (Northing z50)
Koodaideri Iron Ore Project	711482.07	7505254.8
Nyidinghu Iron Ore Project	744288.27	7486579.84
Davidsons Creek DSO	858626	7405472
Pilbara Iron Ore Project - Mindy Mindy	743567.25	7475995.15
West Angelas Iron Ore Project - Deposits A, B, E	682213.88	7438079.9

Processing Hub	Site Location (Easting z50)	Site Location (Northing z50)
West Pilbara IOP	530431.16	7462074.13
Western Turner Syncline - Stage 2 B1, S17 Deposits	548153.72	7488984.5
Yandicoogina - Junction SW, Oxbow Deposits	721419.55	7478325.56
Iron Valley IOP	738030.96	7484471.9
Brockman Syncline 4	522879.29	7501151.5
Cloudbreak IOP	739419.18	7530608.01
Eastern Range - Paraburdoo	560702.16	7430309.75
Hope Downs 1	716498.27	7458127.32
Hope Downs 4	760731.26	7438557.03
Marandoo IOP	620425.78	7494246.47
Marillana IOP	731899.07	7497475.15
Mt. Tom Price	577674.31	7482553.1
Pilbara IOP - Christmas Creek	784143.86	7522039.58
Roy Hill IOP - Stage 1	805065.84	7507364.73
Western Turner Syncline - Section 10	560253.58	7494386.09
Yandicoogina - Junction SE	731814.17	7476441.37
Yandicoogina - Central	728017.92	7480807.27
Koodaideri Iron Ore Project	711482.07	7505254.8

Table E-3 Noise sensitive receiver locations (human and fauna)

Receiver ID	Site Name	Site Location (Easting z50)	Site Location (Northing z50)
PR01	Juna Downs	652321	7468375
PR02	Ethel Creek	825483	7464467
PR03	Marillana	747479	7495073
PR04	Mulga Downs	651662	7555182
PR05	Prairie Downs	719290	7393667
PR06	Sylvania	811750	7388078
PR07	Newman	779758	7414360
PR08	Tom Price	568645	7434001
PR09	Munjina Roadhouse	671172	7521766
PR10	Auskl Village	672582	7524176
PR11	Rocklea	545802	7469519
PR12	Rhodes Ridge	742012	7443807
PR13	Capricorn Roadhouse	787812	7404112
PR14	Cheela Plains	496225	7462730
PR15	Beasley River	497719	7462195

Receiver ID	Site Name	Site Location (Easting z50)	Site Location (Northing z50)
PR16	Mt Robinson	689526	7450659
PR17	Munjina East Gorge	678283	7512021
PR18	Fig Tree Crossing	676697	7505825
PR19	Mt Meharry	662753	7457807
PR20	Mt Newman	761772	7424559
PR21	Ophthalmia Dam	794257	7415934
PR22	Tower Hill	778663	7413664
PR23	Round Hill	783071	7404610
PR24	Hickman Crater	775106	7449800
PR25	Weeli Wolli Spring/Outfall	726288	7464069
PR26	Stuarts Pool	765881	7433047
PR27	Kalgan Pool	776023	7433093
PR28	Eagle Rock Hole	763923	7442594
PR31	Robertson Range	769235	7453385
PR32	Walgunya	717930	7442736
PR33	Jigalong	889310	7400884
PR34	Dales Camping Area	880740	7429256
PR35	Mt Bruce Lookout	886692	7411585
PR44	Karijini Eco Retreat	630018	7523861
PR45	Wirlimura Camp	681819	7546628

APPENDIX F POINT RECEIVER RESULTS FOR SENSITIVE HUMAN RECEIVERS

Table F-1 Point receiver noise levels resulting from mining operations

Receiver ID	Site Name and Description	CURRENT DISTURBANCE SCENARIO Predicted Noise Level in dB(A)			30% DEVELOPMENT SCENARIO Predicted Noise Level in dB(A)			FULL DEVELOPMENT SCENARIO Predicted Noise Level in dB(A)			Assigned Level dB(A)
		BHPBIO	Third Party	SUM	BHPBIO	Third Party	SUM	BHPBIO	Third Party	SUM	
PR01	Juna Downs *homestead*	17.0	14.5	18.9	20.8	17.8	22.6	23.8	17.7	24.8	35
PR02	Ethel Creek *homestead*	1.8	7.6	8.6	14.0	24.0	24.4	16.6	24.0	24.7	35
PR03	Marillana *homestead*	18.2	23.5	24.6	27.6	40.9	41.1	29.2	40.9	41.2	35
PR04	Mulga Downs *homestead*	-0.4	6.4	7.2	6.5	15.7	16.2	9.9	15.7	16.7	35
PR05	Prairie Downs *homestead*	15.6	10.7	16.8	14.2	15.4	17.9	21.6	15.4	22.5	35
PR06	Sylvania *homestead*	18.4	2.3	18.5	25.6	10.0	25.7	26.2	10.0	26.3	35
PR07	Newman *town centre*	30.4	14.2	30.5	**38.2**	18.8	38.2	**38.3**	18.8	38.3	35
PR08	Tom Price *town centre*	-2.3	33.8	33.8	-0.6	33.8	33.8	10.0	33.8	33.8	35
PR09	Munjina *roadhouse*	9.6	11.9	13.9	17.2	25.5	26.1	18.6	25.5	26.3	35
PR10	Auskl Village *roadhouse*	9.4	12.5	14.2	16.8	25.6	26.1	18.7	25.6	26.4	35
PR11	Rocklea *homestead*	-4.2	19.7	19.7	-2.8	22.5	22.5	11.7	22.5	22.8	35
PR12	Rhodes Ridge *town site*	21.8	21.2	24.5	25.0	30.0	31.2	27.6	30.0	32.0	35
PR13	Capricorn *roadhouse*	26.8	9.7	26.9	30.4	15.3	30.5	30.5	15.3	30.6	35
PR14	Cheela Plains *homestead*	-6.9	12.8	12.8	-6.7	13.0	13.0	13.8	13.0	16.4	35
PR15	Beasley River *rest stop*	-6.8	13.0	13.0	-6.6	13.2	13.2	14.6	13.2	17.0	60
PR16	Mt Robinson *rest stop*	10.8	26.5	26.6	27.9	26.5	30.3	29.3	26.5	31.1	60
PR17	Munjina East Gorge *lookout*	14.0	14.0	17.0	21.7	28.9	29.7	22.3	28.9	29.8	60
PR18	Fig Tree Crossing *lookout*	13.7	13.7	16.7	22.8	28.6	29.6	23.8	28.6	29.8	60
PR19	Mt Meharry *lookout*	20.3	19.3	22.8	27.3	21.2	28.3	29.3	21.2	29.9	60
PR20	Mt Newman *lookout*	13.2	22.7	23.2	17.6	25.1	25.8	21.2	25.1	26.6	60
PR21	Ophthalmia Dam *recreation site*	20.2	10.8	20.7	36.4	16.9	36.4	36.5	16.9	36.5	60
PR22	Tower Hill *lookout*	33.9	14.2	33.9	35.8	18.8	35.9	35.9	18.8	36.0	60

Receiver ID	Site Name and Description	CURRENT DISTURBANCE SCENARIO Predicted Noise Level in dB(A)			30% DEVELOPMENT SCENARIO Predicted Noise Level in dB(A)			FULL DEVELOPMENT SCENARIO Predicted Noise Level in dB(A)			Assigned Level dB(A)
		BHPBIO	Third Party	SUM	BHPBIO	Third Party	SUM	BHPBIO	Third Party	SUM	
PR23	Round Hill *recreation site*	34.8	10.7	34.8	32.2	16.0	32.3	32.3	16.0	32.4	60
PR24	Hickman Crater *recreation site*	11.3	20.2	20.7	19.0	25.9	26.7	37.6	25.9	37.9	60
PR25	Weeli Wolli Spring / Outfall *recreation site*	27.6	27.1	30.4	39.4	38.1	41.8	43.3	38.1	44.4	60
PR26	Stuarts Pool *recreation site*	27.8	31.0	32.7	24.7	31.7	32.5	26.8	31.7	32.9	60
PR27	Kalgan Pool *recreation site*	15.4	21.2	22.2	24.0	24.5	27.3	26.3	24.5	28.5	60
PR28	Eagle Rock Hole *recreation site*	16.8	37.7	37.7	20.5	38.0	38.1	28.2	38.0	38.4	60
PR31	Robertson Range *aboriginal comm.*	-4.5	-5.0	-1.7	8.5	6.7	10.7	11.8	6.7	13.0	35
PR32	Walgunya *aboriginal comm.*	-3.3	-3.3	-0.3	10.5	9.2	12.9	13.8	9.2	15.1	35
PR33	Jigalong *aboriginal comm.*	-4.0	-4.5	-1.2	9.4	7.7	11.6	12.8	7.7	14.0	35
PR34	Dales Camp Area *recreation camp site*	8.0	8.1	11.1	16.1	22.9	23.7	17.5	22.9	24.0	60
PR35	Mt Bruce Lookout *lookout*	5.3	20.3	20.4	8.1	20.9	21.1	10.5	20.9	21.3	60
PR44	Karijini Eco Retreat *recreation camp site*	0.6	8.9	9.5	7.9	15.1	15.9	10.3	15.1	16.3	60
PR45	Wirlimura Camp *Aboriginal camp site*	8.7	14.0	15.1	12.9	23.4	23.8	18.3	23.4	24.6	35

Table F-2 Point receiver noise levels resulting from BHP Billiton Iron Ore rail operations

Receiver ID	Site Name and Description	CURRENT DISTURBANCE SCENARIO	30% DEVELOPMENT SCENARIO	FULL DEVELOPMENT SCENARIO	Noise Limit (Target) dB(A)
		Predicted Noise Level in dB(A)	Predicted Noise Level in dB(A)	Predicted Noise Level in dB(A)	
PR01	Juna Downs *homestead*	-1.3	5.7	7.0	50 (55)
PR02	Ethel Creek *homestead*	3.0	7.0	7.0	50 (55)
PR03	Marillana *homestead*	29.9	34.7	34.7	50 (55)
PR04	Mulga Downs *homestead*	4.1	7.3	8.8	50 (55)
PR05	Prairie Downs *homestead*	-4.1	1.1	1.5	50 (55)
PR06	Sylvania *homestead*	2.7	7.3	7.1	50 (55)
PR07	Newman *town centre*	29.7	31.7	31.7	50 (55)
PR08	Tom Price *town centre*	-15.3	-10.5	-9.2	50 (55)
PR09	Munjina *roadhouse*	7.4	10.7	12.2	50 (55)
PR10	Auskl Village *roadhouse*	8.4	11.7	13.1	50 (55)
PR11	Rocklea *homestead*	-15.7	-11.6	-10.3	50 (55)
PR12	Rhodes Ridge *town site*	5.1	11.2	11.5	50 (55)
PR13	Capricorn *roadhouse*	13.1	15.8	15.9	50 (55)
PR14	Cheela Plains *homestead*	-21.3	-17.6	-16.3	50 (55)
PR15	Beasley River *rest stop*	-21.2	-17.4	-16.0	50 (55)
PR16	Mt Robinson *rest stop*	3.5	21.2	21.3	50 (55)
PR17	Munjina East Gorge *lookout*	8.9	12.1	13.9	50 (55)
PR18	Fig Tree Crossing *lookout*	7.6	11.4	12.9	50 (55)
PR19	Mt Meharry *lookout*	-1.9	10.9	11.7	50 (55)
PR20	Mt Newman *lookout*	9.3	12.8	12.9	50 (55)
PR21	Ophthalmia Dam *recreation site*	25.9	31.2	31.2	50 (55)
PR22	Tower Hill *lookout*	30.0	32.0	32.0	50 (55)
PR23	Round Hill *recreation site*	14.4	16.2	16.2	50 (55)
PR24	Hickman Crater *recreation site*	16.4	20.3	20.3	50 (55)

Receiver ID	Site Name and Description	CURRENT DISTURBANCE SCENARIO	30% DEVELOPMENT SCENARIO	FULL DEVELOPMENT SCENARIO	Noise Limit (Target) dB(A)
		Predicted Noise Level in dB(A)	Predicted Noise Level in dB(A)	Predicted Noise Level in dB(A)	
PR25	Weeli Wolli Spring / Outfall *recreation site*	12.5	36.2	36.2	50 (55)
PR26	Stuarts Pool *recreation site*	9.5	13.2	13.3	50 (55)
PR27	Kalgan Pool *recreation site*	11.4	15.1	15.2	50 (55)
PR28	Eagle Rock Hole *recreation site*	8.8	13.0	13.1	50 (55)
PR31	Robertson Range *aboriginal comm.*	-10.9	-6.6	-6.5	50 (55)
PR32	Walgunya *aboriginal comm.*	-8.1	-3.9	-3.8	50 (55)
PR33	Jigalong *aboriginal comm.*	-9.9	-5.6	-5.5	50 (55)
PR34	Dales Camp Area *recreation camp site*	3.8	7.4	8.8	50 (55)
PR35	Mt Bruce Lookout *lookout*	-5.2	-0.9	0.5	50 (55)
PR44	Karijini Eco Retreat *recreation camp site*	-1.5	2.0	3.3	50 (55)
PR45	Wirlimura Camp *Aboriginal camp site*	11.8	14.8	16.5	50 (55)

APPENDIX G SOUND POWER LEVELS FOR REFERENCE MINE SITES

The following two comprehensive noise models were used to estimate the reference processing hub sound power levels:

1. MAC environmental noise model for Expansion P1W and P1E which delivers 45 Mtpa of iron ore (and thus corresponds to a typical mine site production rate); and
2. Orebody 24 environmental noise model which is representative of a medium capacity mine with a production rate of 18 Mtpa (assumed to be representative of a 20 Mtpa mine).

Reference noise models listed above are representative of a typical large and medium sized processing hubs.

Tables included in Appendix H represent the sound power levels used previously to model the noise impacts from the two operations listed above.

Table G-1 Sound power levels used to model environmental noise impacts for Orebody 24

Source	Octave Band Sound Power Levels in dB									TOTAL
	31	63	125	250	500	1k	2k	4k	8k	dB(A)
OVERLAND CONVEYOR	81.8	99.9	114.0	120.8	124.3	123.8	121.9	113.8	102.8	129.2
CONVEYOR DRIVES (10)	30.2	66.6	89.0	102.3	110.5	123.4	115.4	108.5	94.9	124.4
TRANSFER STATION	72.7	91.4	101.9	112.0	114.7	117.6	116.2	111.9	101.6	122.1
CHUTE AND DRIVES	72.7	91.4	101.9	112.0	114.7	117.6	116.2	111.9	101.6	122.1
TRANSFER STATION	72.7	91.4	101.9	112.0	114.7	117.6	116.2	111.9	101.6	122.1
TRANSFER STATION -	72.7	91.4	101.9	112.0	114.7	117.6	116.2	111.9	101.6	122.1
TRANSFER STATION -	72.7	91.4	101.9	112.0	114.7	117.6	116.2	111.9	101.6	122.1
TRANSFER STATION	72.7	91.4	101.9	112.0	114.7	117.6	116.2	111.9	101.6	122.1
TRANSFER STATION	72.7	91.4	101.9	112.0	114.7	117.6	116.2	111.9	101.6	122.1
TRANSFER STATION	72.7	91.4	101.9	112.0	114.7	117.6	116.2	111.9	101.6	122.1
CONVEYORS OB25	73.7	91.8	105.9	112.7	116.2	115.7	113.8	105.7	94.7	121.1
RECELAIMER CONVEYOR	73.7	91.8	105.9	112.7	116.2	115.7	113.8	105.7	94.7	121.1
PRIMARY CRUSHER -	77.4	91.2	103.9	114.4	115.8	113.0	113.2	107.0	98.1	120.6
STACKER CONVEYOR	71.5	89.6	103.7	110.5	114.0	113.5	111.6	103.5	92.5	118.9
CONVEYORS OB25	71.1	89.2	103.3	110.1	113.6	113.1	111.2	103.1	92.1	118.5
RECLAIMER 1	64.9	87.3	98.1	112.7	109.9	112.7	106.7	101.0	90.5	117.3
RECLAIMER 2	64.9	87.3	98.1	112.7	109.9	112.7	106.7	101.0	90.5	117.3
OB25 RECLAIMER	64.9	87.3	98.1	112.7	109.9	112.7	106.7	101.0	90.5	117.3
OB25 RECLAIMER	64.9	87.3	98.1	112.7	109.9	112.7	106.7	101.0	90.5	117.3
CONVEYORS OB25	69.7	87.8	101.9	108.7	112.2	111.7	109.8	101.7	90.7	117.1
STACKER 1	66.4	86.5	98.2	106.0	110.7	113.4	108.3	101.5	91.2	116.7
STACKER 2	66.4	86.5	98.2	106.0	110.7	113.4	108.3	101.5	91.2	116.7
STACKER 2	66.4	86.5	98.2	106.0	110.7	113.4	108.3	101.5	91.2	116.7
CONVEYORS OB25	67.9	86.0	100.1	106.9	110.4	109.9	108.0	99.9	88.9	115.3
SECONDARY CRUSHER	73.2	90.4	95.8	104.7	110.5	107.1	108.3	104.3	95.0	114.7
OB25 EXISTING CRUSHER	73.2	90.4	95.8	104.7	110.5	107.1	108.3	104.3	95.0	114.7
RECLAIMER CONVEYOR	67.2	85.3	99.4	106.2	109.7	109.2	107.3	99.2	88.2	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6

Source	Octave Band Sound Power Levels in dB									TOTAL
	31	63	125	250	500	1k	2k	4k	8k	dB(A)
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
CONVEYOR DRIVE	59.6	82.8	95.1	100.9	103.7	113.4	104.2	97.5	86.0	114.6
SCALPING SCREEN	86.8	90.6	97.7	101.8	105.3	107.0	108.4	108.3	102.1	114.3
SCREENHOUSE	86.8	90.6	97.7	101.8	105.3	107.0	108.4	108.3	102.1	114.3
DOZER	69.6	85.4	98.1	104.4	109.5	109.2	105.7	96.3	83.3	114
TRANSFER CONVEYOR	65.8	83.9	98.0	104.8	108.3	107.8	105.9	97.8	86.8	113.2
CONVEYORS OB25	64.7	82.8	96.9	103.7	107.2	106.7	104.8	96.7	85.7	112.1
CONVEYOR TO TRAIN	64.2	82.3	96.4	103.2	106.7	106.2	104.3	96.2	85.2	111.6
SERVICE TRUCK	-	77.5	97.8	102.8	107.3	105.6	103.1	99.5	87.5	111.6
SERVICE TRUCK	-	77.5	97.8	102.8	107.3	105.6	103.1	99.5	87.5	111.6
SERVICE TRUCK	-	77.5	97.8	102.8	107.3	105.6	103.1	99.5	87.5	111.6
SERVICE TRUCK	-	77.5	97.8	102.8	107.3	105.6	103.1	99.5	87.5	111.6
SERVICE TRUCK	-	77.5	97.8	102.8	107.3	105.6	103.1	99.5	87.5	111.6
GRADER	58.0	76.5	92.2	93.9	102.5	106.7	105.4	100.8	90.6	110.7
CONVEYORS OB25	63.2	81.3	95.4	102.2	105.7	105.2	103.3	95.2	84.2	110.6
CONVEYORS OB25	63.1	81.2	95.3	102.1	105.6	105.1	103.2	95.1	84.1	110.5
LIGHT VEHICLE X 17	66.1	76.1	87.2	93.7	104.1	103.3	102.5	98.3	89.4	108.8
HAUL TRUCK	82.7	89.3	104.2	97.3	103.8	100.9	95.8	91.6	84.5	108.7
HAUL TRUCK	82.7	89.3	104.2	97.3	103.8	100.9	95.8	91.6	84.5	108.7
HAUL TRUCK	82.7	89.3	104.2	97.3	103.8	100.9	95.8	91.6	84.5	108.7
HAUL TRUCK	82.7	89.3	104.2	97.3	103.8	100.9	95.8	91.6	84.5	108.7

Source	Octave Band Sound Power Levels in dB									TOTAL
	31	63	125	250	500	1k	2k	4k	8k	dB(A)
HAUL TRUCK	82.7	89.3	104.2	97.3	103.8	100.9	95.8	91.6	84.5	108.7
HAUL TRUCK	82.7	89.3	104.2	97.3	103.8	100.9	95.8	91.6	84.5	108.7
HAUL TRUCK	82.7	89.3	104.2	97.3	103.8	100.9	95.8	91.6	84.5	108.7
HAUL TRUCK	82.7	89.3	104.2	97.3	103.8	100.9	95.8	91.6	84.5	108.7
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LOADER	60.9	83.2	93.9	96.0	102.4	103.9	101.8	96.9	88.0	108.4
LIGHT VEHICLE X 5	60.8	69.8	81.9	88.4	98.8	98.0	97.2	93.0	84.1	103.5
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4
LIGHTING	-	41.4	62.0	60.3	68.4	60.4	72.4	65.1	75.7	79.4

Table G-2 Sound power levels used to model environmental noise impacts for MAC Expansions P1W and P1E Gate

Source	Octave Band Sound Power Levels in dB									TOTAL
	31	63	125	250	500	1k	2k	4k	8k	dB(A)
GRADER EXTRA 1	99.7	102.7	108.4	102.6	105.7	106.7	104.2	99.8	93.5	125.1
GRADER EXTRA 2	99.7	102.7	108.4	102.6	105.7	106.7	104.2	99.8	93.5	127.5
GRADER EXTRA 3	99.7	102.7	108.4	102.6	105.7	106.7	104.2	99.8	93.5	129
WATER CART EXTRA 1		103.7	114	111.5	110.5	105.6	101.9	98.5	90.4	122.4
WATER CART EXTRA 2		103.7	114	111.5	110.5	105.6	101.9	98.5	90.4	121.1
GRADER 1	99.7	102.7	108.4	102.6	105.7	106.7	104.2	99.8	93.5	121.1
GRADER 2	99.7	102.7	108.4	102.6	105.7	106.7	104.2	99.8	93.5	117.7
GRADER 3	99.7	102.7	108.4	102.6	105.7	106.7	104.2	99.8	93.5	121.1
GRADER 4	99.7	102.7	108.4	102.6	105.7	106.7	104.2	99.8	93.5	114
DIGGER 1	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	114
DIGGER 2	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	114
DIGGER 3	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	114
DIGGER 4	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	114
DIGGER 5	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	118.9
DIGGER 6	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	118.9
DRILL 1	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	118.9
DRILL 2	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	118.9
DRILL 3	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	118.9
DRILL 4	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	118.9
DRILL 5	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	118.9
DRILL 6	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	118.9
DRILL 7	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	118.9
DRILL 8	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	118.9
EXCAVATOR 1	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	118.9
EXCAVATOR 2	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	118.9
EXCAVATOR 3	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	112.8
EXCAVATOR 4	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	112.8
EXCAVATOR 5	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	112.8
EXCAVATOR 6	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	112.8
EXCAVATOR 7	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	112.8
EXCAVATOR 8	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	112.8

Source	Octave Band Sound Power Levels in dB									TOTAL
	31	63	125	250	500	1k	2k	4k	8k	dB(A)
EXCAVATOR 9	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	112.8
WATER CART 1	104.2	113.9	111.5	110.6	105.6	101.9	98.5	90.4		112.8
WATER CART 2	104.2	113.9	111.5	110.6	105.6	101.9	98.5	90.4		112.8
WATER CART 3	104.2	113.9	111.5	110.6	105.6	101.9	98.5	90.4		112.8
DOZER 1	111.3	111.6	114.3	113.1	112.7	109.2	104.5	95.3	86.2	112.8
DOZER 2	111.3	111.6	114.3	113.1	112.7	109.2	104.5	95.3	86.2	112.8
DOZER 3	111.3	111.6	114.3	113.1	112.7	109.2	104.5	95.3	86.2	112.8
DOZER 4	111.3	111.6	114.3	113.1	112.7	109.2	104.5	95.3	86.2	112.8
DOZER 5	111.3	111.6	114.3	113.1	112.7	109.2	104.5	95.3	86.2	112.8
DRILL P1E 1	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	112.8
DRILL P1E 2	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	112.8
DRILL P1E 3	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	112.8
DRILL P1E 4	109	112.3	126.3	120.1	117.2	111	109.4	105	97.8	110.7
EXCAVATOR P1E 2	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	110.7
EXCAVATOR P1E 1	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	110.7
EXCAVATOR P1E 3	107.6	114.7	116.6	113.2	111	107.2	103.7	96.7	88.3	110.7
GRADER 1	99.7	102.7	108.4	102.6	105.7	106.7	104.2	99.8	93.5	110.7
GRADER 2	99.7	102.7	108.4	102.6	105.7	106.7	104.2	99.8	93.5	110.7
GRADER 3	99.7	102.7	108.4	102.6	105.7	106.7	104.2	99.8	93.5	110.7
TRUCK P1E 2	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	110.7
TRUCK P1E 3	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	110.7
TRUCK P1E 1	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	110.7
TRUCK P1E 4	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK P1E 7	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK P1E 6	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK 11	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK P1E 5	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK P1E 9	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK P1E 8	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK P1E 10	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK 12	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK 13	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1

Source	Octave Band Sound Power Levels in dB									TOTAL
	31	63	125	250	500	1k	2k	4k	8k	dB(A)
TRUCK 14	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK 15	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK 16	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK 17	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK 18	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK 19	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK 20	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
TRUCK 21	111.5	111.4	115.7	111	112.2	107.9	107.7	98	92.2	114.1
WATER CART 1	104.2	113.9	111.5	110.6	105.6	101.9	98.5	90.4		114.1
WATER CART 2	104.2	113.9	111.5	110.6	105.6	101.9	98.5	90.4		114.1
TRUCK 3	104.2	113.9	111.5	110.6	105.6	101.9	98.5	90.4		114.1
31 TRUCKS AS ONE	126.4	126.3	130.6	125.9	127.2	122.8	122.6	112.9	107.2	134
7 DOZERS	119.7	120.1	122.7	121.5	121.2	117.7	112.9	103.8	94.7	111.6
13 DOZERS	122.4	122.8	125.4	124.2	123.9	120.3	115.6	106.5	97.4	111.6
22 TRUCKS AS ONE	124.9	124.8	129.1	124.4	125.7	121.3	121.1	111.5	105.7	108
CV WEST	114.9	120.1	121.7	119.8	119.4	116.8	111.3	105.8	99.3	108
CV CENTRE	114.9	120.1	121.7	119.8	119.4	116.8	111.3	105.8	99.3	108
CV EAST	114.9	120.1	121.7	119.8	119.4	116.8	111.3	105.8	99.3	108
CV SOUTH	111.5	116.7	118.3	116.4	116	113.4	107.9	102.4	95.9	108
PARABURDOO PLANT	136.5	137	133.1	132.1	132	129	125	123	117	108

Table G-3 Summary of equipment entered into the model for MAC Expansions P1W and P1E Gate 2A

Source	P1W/P1E Deposit	Waste Pit and ROM Road	Stockyard C	Area C	TOTAL
HAUL TRUCK	14	7	31	45	97
GRADER	0	3	0	7	10
WATER TRUCK	0	3	0	5	8
DOZER	5	0	13	7	25
DRILL	6	0	0	19	25
EXCAVATOR	3	0	0	17	20
FIXED PLANT	0	0	1	0	1
CONVEYER	0	0	3	0	3