APPENDIX U

Noise and Vibration Assessment

CLIENTS | PEOPLE | PERFORMANCE

Vista Gold Australia Pty Ltd

Mt Todd Gold Project

Noise and Vibration Assessment

June 2013

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

This Report has been prepared by GHD for Vista Gold Australia Pty Ltd (Vista Gold) and *may only be used and relied on by Vista Gold for the purpose agreed between GHD and Vista Gold as set out in section 1 of this report.*

GHD otherwise disclaims responsibility to any person other than Vista Gold arising from or in connection with this Report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this Report were limited to those specifically detailed in this Report and are subject to the scope limitations set out in the Report.

It is not the intention of the Report to cover every element of the acoustic environment, but rather to conduct the assessment with consideration to the services detailed in Section 1.2.

The opinions, conclusions and any recommendations in this Report are based on conditions encountered and information reviewed at the date of preparation of the Report. GHD has no responsibility or obligation to update this Report to account for events or changes occurring subsequent to the date that the Report was prepared.

The opinions, conclusions and any recommendations in this Report are based on assumptions made by GHD described throughout this Report. GHD disclaims liability arising from any of the assumptions being incorrect.

Contents

Table Index

Figure Index

Appendices

Glossary – Noise and Vibration Terms

Term	Definition
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dB(A)	Frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.
$L_{Aeq(period)}$	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
$L_{A10(period)}$	The sound pressure level that is exceeded for 10% of the measurement period.
$L_{A90(period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
L_{Amax}	The maximum sound level recorded during the measurement period.
$L_{A1(period)}$	The sound pressure level that is exceeded for 1% of the measurement period.
Rating Background Level (RBL)	The overall single-figure background level representing each assessment period (day / evening / night) over the whole monitoring period.
Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).
Ground borne vibration	Ground borne vibration is vibration transmitted from source to receptor via the medium of the ground.
Ground borne noise	Ground borne noise describes noise transmitted as vibration through the ground and into structures, radiated as low frequency rumbling noise.
Peak Particle Velocity	Current practice for assessments of the risk of structural damage to buildings use measurements of Peak Particle Velocity (PPV) ground vibration (v_p), which is the maximum vector sum of three orthogonal time-synchronised velocity components.
RMS	Root mean square.

Executive Summary

Vista Gold Australia Pty Ltd (Vista Gold) is proposing to develop the Mt Todd Gold Project (the Project) consisting of the re-establishment, operation and rehabilitation of the Mt Todd Gold Mine.

This report has been prepared to assess potential noise and vibration impacts relevant to the construction and operation of the Project and will form part of an Environmental Impact Statement.

Baseline Monitoring

Baseline noise monitoring was conducted at two locations in the vicinity of the Project area. Operational noise criteria were determined based on background noise monitoring results and with consideration to the New South Wales Industrial Noise Policy (INP) (EPA, 2000), in the absence of Northern Territory noise and vibration guidelines or criteria. Construction and operational noise and vibration criteria including blasting vibration and overpressure criteria are outlined in this report.

Construction Noise and Vibration

The results of the construction assessment indicate that the construction noise and vibration impact of the mine are expected to comply with the project specific noise criteria at all sensitive receptors.

Operational Noise and Vibration

Acoustic modelling was undertaken to predict the effects of operational noise from the Project. The results of the operational assessment indicate that the operational noise and vibration impact of the Mt Todd Gold Mine are expected to comply with the project specific noise criteria at all known sensitive receptors assessed under neutral and adverse weather conditions and under the modelling assumptions outlined in this report.

The estimated increase in traffic noise levels due to the Project is not expected to be noticeable to the Werenbun receptor.

Airblast overpressure and ground vibration from blasting activities at the mine are predicted to be below the allowable criteria outlined in the ANZECC Guidelines.

Based on available literature it is unlikely that any adverse noise and vibration impacts on livestock and native fauna would be associated with the Project. As such, no specific noise and vibration mitigation measures are required.

Although not expected to cause adverse noise impacts, it is recommended that the management measures detailed in this report be considered for operation of the Project, in order to minimise the risk of noise impact.

1. Introduction

1.1 Background

Vista Gold Australia Pty Ltd (Vista Gold) is proposing to develop the Mt Todd Gold Project (the Project) by undertaking the re-establishment, operation and rehabilitation of the Mt Todd Gold Mine.

The Mt Todd Gold Mine site is located approximately 55 km north-west of Katherine and 250 km south of Darwin in the Northern Territory.

GHD has been engaged to prepare a draft Environmental Impact Statement (EIS) on behalf of Vista Gold. This report provides the relevant noise and vibration information requirements outlined in the Guidelines for the Preparation of an EIS (EPA (formerly NRETAS) September 2011).

Table 1 provides a cross-reference with the section of this report and the Project EIS requirements.

Table 1 Project EIS Requirements Cross Reference

Section Number	Project EIS Requirement	Is this included in this report?	Section of this report
Section 7.6	The ability of identified stands of vegetation and fauna to withstand any increased pressure resulting from the Project (e.g., increase in dust, light, noise, vibration, traffic and fire) and measures proposed to mitigate impacts.	Yes	Section 5.3.6
Section 10.3	Describe proposed safeguards, management and monitoring strategies that will be implemented to minimise potential transport impacts during construction and operation including, but not limited to: ◗ Measures to reduce any road traffic noise impacts.	Yes	Section 5.3.4

1.2 Scope of Work

The scope of works for the noise and vibration impact assessment, as a component study required for the EIS is as follows:

- Initial desk top review to identify key environmental noise catchment areas and noise sensitive receptors from aerial photography;
- Unattended noise monitoring for a period of one week at two (2) locations. One logger was deployed close to and representative of the nearest residential receiver, and one logger was deployed at the site boundary.

  Attended noise measurements have also been undertaken at the existing site, as well as around the nearest noise sensitive receptor (Werenbun community) to supplement the unattended measurements.

- Based on monitoring results, determination of project specific noise and vibration goals for the construction and operation of the proposed Mount Todd Mine, with consideration to the following guidelines:
  – NT EPA – Noise guidelines for development sites in the Northern Territory (NT EPA 2013).
  – NSW Environment Protection Authority (NSW EPA) Industrial Noise Policy (2000), in the absence of equivalent NT noise guidelines;
- Identification of the likely principal noise and vibration sources during construction and operation;
- Noise modelling using Computer Aided Noise Abatement (CadnaA) software to predict sound pressure levels emanating from the proposed operation of the mine site at the nearest identified noise receiver;
- Desktop noise assessment of construction activities;
- Desktop assessment of blasting vibration and overpressure impacts; and
- Provision of in-principle noise and vibration mitigation measures.

2. Project Description

The Mt Todd Gold Mine site is a brownfield/disturbed site that was most recently mined for gold in the 1990's until the year 2000. Mining infrastructure such as tailing dams, waste rock dumps and remains of processing facilities remain on site.

The Project, based on current known data, will have a life of around 19 years inclusive of construction, operations and closure. Construction is anticipated to commence in the first quarter of 2014 and take two years, including 6 months pre-production. The mine is scheduled to operate for a further 13 years. Closure and rehabilitation of the mine is expected to take four years.

The construction and operations workforces are expected to peak at 450 and 350 personnel respectively.

The Project area is shown in (Figure 1). The key elements of the Project are listed in the Sections below.

2.1 Mining and Mining Infrastructure

- extension of the existing Batman Pit from its current depth of 114 m to approximately 588 m (RL -400 m) and surface area of 40 hectares (ha) to approximately 137 ha;
- expansion of the existing waste rock dump (WRD) from a height of 24 m above ground level to approximately 350 m above ground level (RL 470 m), and a footprint of 70 ha to approximately 217 ha. The dump currently contains 16 Mt of waste rock and the expansion will provide total capacity of up to 510 Mt;
- construction of a Run of Mine (ROM) pad and ore stockpile;
- construction of an Ammonium Nitrate and Fuel Oil (ANFO) Facility;
- construction of heavy and light vehicle workshop and administration offices, and facilities comprising wash down area, tyre change facility, lube storage facility etc; and
- construction of haul roads and access roads.

2.1.1 Process Plant and Associated Facilities

- Ore Processing Plant capable of processing approximately 50,000 tonnes per day (tpd) of ore;
- processing and / or reclamation of the existing low grade ore (LGO) stockpile and scats stockpile, and construction and processing of new LGO stockpile with a footprint of approximately 47 ha;
- raising the existing tailings storage facility (TSF1) from 16 m to approximately 34 m above ground level;
- construction of a new tailing storage facility (TSF2), approximately 300 ha in area and up to 60 m high (RL 175 m);
- diversion of Horseshoe Creek and Stow Creek adjacent to TSF2 to provide flood protection;
- rehabilitation of the existing heap leach pad (HLP), if residual HLP material is not processed through the new plant;
- chemical and reagent storage and handling facility; and
- process plant workshops, administration offices, control room etc.

2.1.2 Other Infrastructure

- gas-fired power station, including re-routing of the existing gas pipeline;
- anaerobic treatment wetlands, approximately 10 ha in area;
- a 2 m high raising of the raw water dam (RWD) and an increase in the area of inundation;
- construction of saddle dams at the RWD and TSF1;
- construction of three coffer dams at Retention Pond 1 (RP1) and deepening of RP1;
- water treatment plant;
- security gate house;
- potential re-alignment of access roads;
- site wide drainage, sediment traps; and
- modification to existing fuel storage and distribution facility.

2.2 Mining Operations and Processing

2.2.1 Mine Production Schedule and Pit Development

Proven and probable reserves have been used to schedule mine production. The production schedule of up to 216 Mt of processed ore will occur over a 13 year period not including pre-production mining during the construction phase.

Based on a review of geological data and current bench slopes, a detailed pit design has been completed. The ultimate pit is achieved by mining in four separate phases, or cut backs, outlined below:

- phase one: mining during pre-production starts from the current pit pushback limit that was started by previous operators and mines it to RL -188 m;
- phase 2: during year 1 mining around the phase 1 pit and deepens the mined pit to RL -246 m;
- phase 3: during year 3 mining around the south end of the phase 2 pit and achieves a RL of -336 m;
- phase 4: during year 5 completion of mining in the north and below phase 3 to a RL of -400 m.

2.2.2 Mining

Mine operations will be 24 hour, split across two shifts (6:00 am – 6:00 pm and 6:00 pm – 6:00 am).

Drilling and blasting, to loosen rock ahead of mining, will be undertaken in order to produce rock sizes that conform to processing requirements. Blasted ore will be loaded into haul trucks for transportation either directly to the primary crusher, ROM pad or LGO. Ore will be reclaimed from the ROM pad and LGO by front-end loader and fed to the primary crusher.

The Batman Pit will be significantly deepened and enlarged from its current depth of 114 m to a proposed depth of 588 m (RL - 400). The surface area of the pit will be increased from approximately 40 ha to 137 ha.

Rock will be blasted and mined by conventional truck and shovel methods. Walls will be scaled during the mining operation in order to maintain a safe work place. Safety berms will be utilised as required to maintain safe working areas. In some cases, primarily on the east wall, these safety berms will be incorporated into haul roads. Where this is done, a berm along the road will be built to contain any sloughing material.

The pit will incorporate 6 m benches for mining. In areas where the material is consistently ore or waste, benches may be mined in 12 m heights.

Water will be sprayed onto roads to suppress dust using a water cart. Environmentally benign surfactants will also be used on road surfaces to reduce the water demand for dust suppression where practical and economically viable.

2.2.3 Ore Processing

A new ore processing facility will be constructed on the previous process plant site. The existing disturbed area will not change significantly.

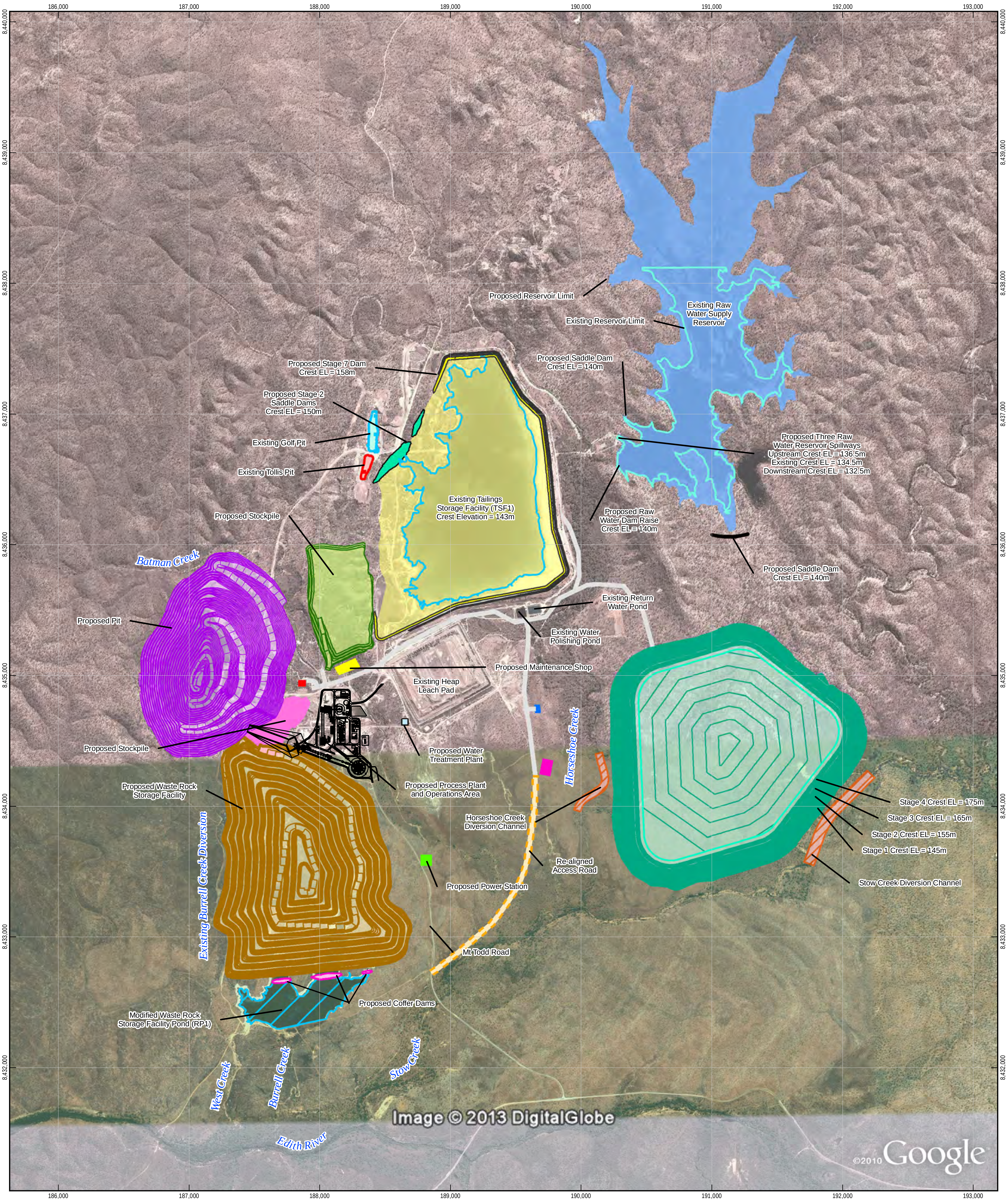
The process plant has been designed to treat free milling ore using conventional technology to recover cyanide leachable gold using a carbon in leach (CIL) process.

The process plant will consist of a gyrator crusher, secondary crushers, coarse screening, coarse ore stockpile, high pressure grinding rolls (HPGR), fine screening, classification, ball mills, pre-leach thickener, CIL circuit, elution circuit, gold room, cyanide detoxification and tailings pumps. Support services include reagent mixing and dosing facilities, and a centralised control room.

The following are key components of the Ore Processing Plant:

- Comminution (crushing and grinding of ore);
- Adsorption and detoxification; and
- Gold extraction.

Figure 2 illustrates the ore processing plant layout.



LEGEND

Process Plant	Power Plant	Explosives Magazine	TSF1 Existing Water Body	TSF2 Impounded Surface Area (Year 12)
Proposed Saddle Dam (Raw Water Dam)	Stockpile	Golf Pit	Proposed Haul Road	Diversion Channels
Proposed Saddle Dam	TSF2 Contours (Year 12)	Retention Pond 1	Tollis Pit	Re-aligned Access Road
Raw Water Dam Existing Water Body	TSF1	TSF2 Footprint (Year 12)	Batman Pit Footprint (Year 12)	Fuel Bays
Coffer Dams	Indicative Raw Water Dam	Low Grade Ore Stockpile Contours	Water Treatment Plant	Waste Rock Dump Contours (Year 10)
Proposed Maintenance Shop	ANFO Facility	TSF1 Contours	Low Grade Ore Stockpile	Batman Pit Contours (Year 12)
Waste Rock Dump Footprint (Year 10)				

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number 43-21801
Revision 1
Date 13 Jun 2013

Project Area

Figure 1

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_401.mxd

66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013). GHD - Creek Names (2011). Created by: CM

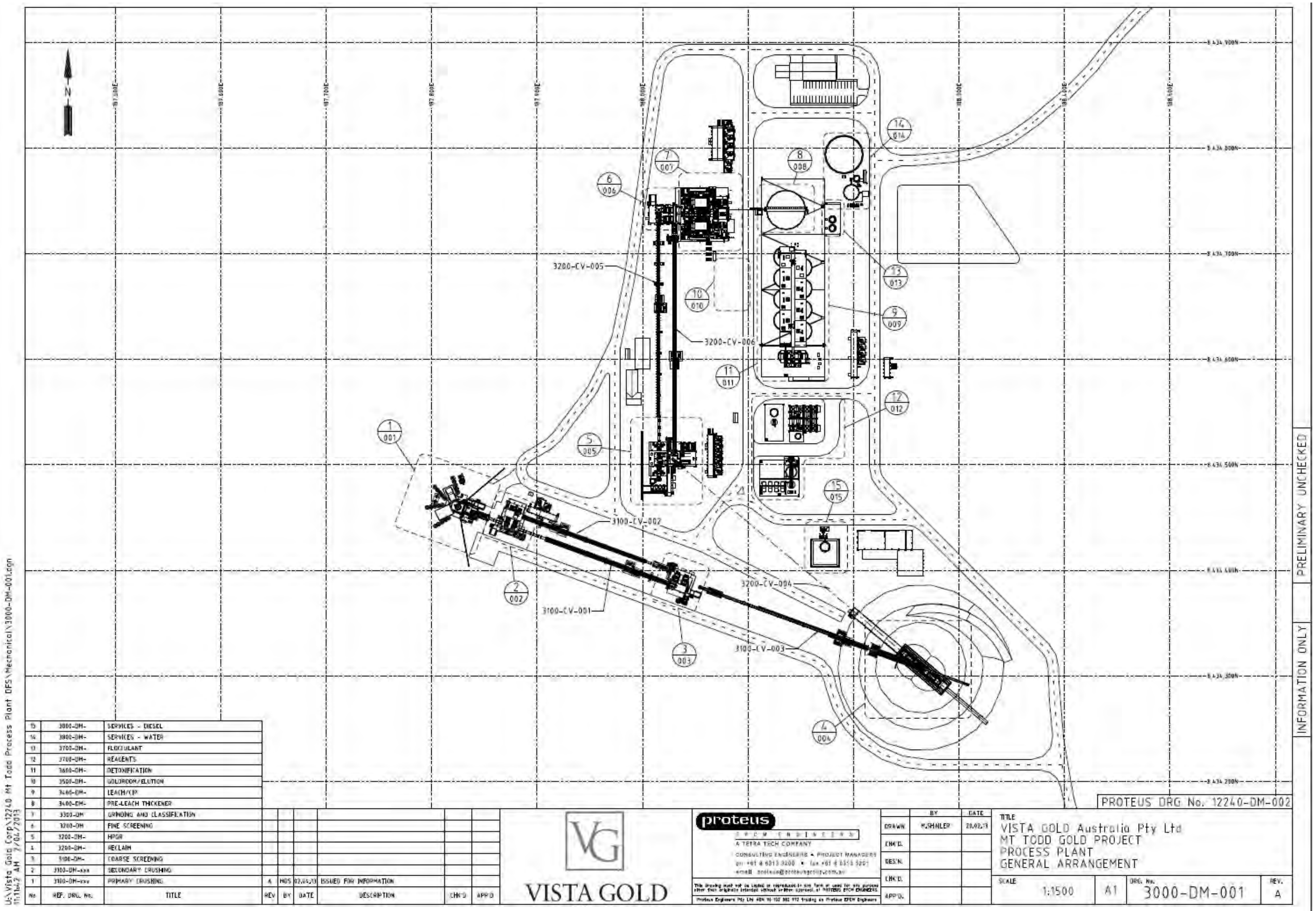


Figure 2 Process Plant Layout

2.2.4 Comminution

Ore will be fed into a primary gyratory crusher, either directly by haul truck from the pit or by front-end loader from the ROM pad and LGO. Ore contained within the existing LGO stockpile and scats from the scats stockpile will also be reprocessed. Primary crusher product will be reclaimed from the discharge vault by the apron feeder and discharged onto a conveyor.

Primary crushed ore will be secondary crushed using cone crushers. Crusher product will be screened on banana screens with oversize transferred back to the secondary crusher feed conveyor. Screen undersize will be transferred onto a coarse ore stockpile where ore will be reclaimed by a feeder, onto a conveyor to the High Pressure Grinding Rolls (HPGR). HPGR product will be conveyed by belt conveyors to a fine ore splitter where it will be transferred across a fine ore screen by two belt conveyors operating in parallel. Screen oversize will be conveyed back to the HPGR feed conveyor with undersize gravitating to a hydrocyclone feed sump. Slurry from the feed sump will be pumped into a hydrocyclone cluster. Hydrocyclone underflow gravitates to two ball mills where it will undergo further size reduction. The hydrocyclone overflow slurry will flow by gravity onto three trash removal screens. Screen undersize slurry will gravitate into a pre-leach thickener, after which thickened slurry will be pumped to the CIL circuit.

2.2.5 Adsorption and Detoxification

The CIL circuit will consist of a pre-leach thickening stage followed by conventional leaching and adsorption. Pre-aeration reduces cyanide consumption during CIL leaching. Cyanide will be added to the slurry to dissolve the gold after which carbon is added to adsorb the solubilised gold. Reactivated carbon, supplemented with fresh carbon as necessary, will be added to the final tank in the circuit.

CIL plant tailing will be directed to a cyanide detoxification circuit in which the cyanide is reduced and / or eliminated. The slurry exiting the detoxification tanks will gravitate into a tailings pump hopper. From here the slurry will be pumped to tailings storage.

2.2.6 Transport and Ancillary Operations

The gold bars will be stored in a secured area at the project site and transported by secure shipment to a refinery.

Carbon will be regularly washed in a mild cold hydrochloric acid wash which removes carbonates that may have built up on the carbon during the CIL process. Carbon activity is reduced after use in the CIL leaching process. Carbon reactivation will be undertaken in a reactivation kiln after carbon stripping. The reactivated carbon will be screened to remove carbon fines and reintroduced into the CIL circuit.

2.2.7 Site Vehicles

Vehicles will operate at Mt Todd to undertake mining, stockpile management, plant feeding, road maintenance, dust suppression, general personnel movement etc. The vehicle fleet will include:

- 8 Atlas Copco Pit Vider 235 blast-hole drills;
- 1 Atlas Copco 45K rotary drill rig;
- 2 ammonium nitrate / fuel oil truck;
- 2 Cat 834H rubber tire dozer;
- 1 36t capacity crane;
- 1 Cat 321DL excavator;

- 1 skid loader;
- 4 Hitachi EX5500 hydraulic shovels;
- 2 Cat 994 loader;
- up to 38 Cat 793C trucks during the mine life;
- 1 Cat D8 track dozer;
- 2 Cat D9 track dozers;
- 2 Cat 16H motor grader;
- 2 Cat 777B with a 70kL water truck;
- 1 low-boy trailer with 60t haul truck;
- 1 flatbed truck;
- 1 rock breaker attached to the 321DL excavator;
- 4 light plants;
- 1 fuel / lube truck;
- 16 4WD utes; and
- 2 passenger vans.

2.2.8 Infrastructure

Power Supply

During operations, site electrical normal demand (steady state) is 86MW and the peak demand is approximately 95MW.

Electrical demand will be met by the installation of Rolls Royce Trent 60 Wet Low Emissions single gas turbine generator (Figure 3) and two reciprocating engines (Figure 4) located along the south side of the main entrance road. Any shortfall to meet power demand will be drawn from the utility grid.

The flue gas nominal stack exit conditions for the Rolls-Royce Trent 60 gas turbine were given as:

- Mass flow rate of 166 kg/s;
- Exit velocity of 48.3 m/s;
- Exit temperature of 422 ˚C; and
- A single discharge vertical stack of:
  - Stack height of 21.3 m; and
  - Stack diameter of 3.05 m.

The flue gas nominal stack exit conditions for the two MAN 20V35/44 gas engines were given as follows:

- Exit velocity of 12.5 m/s;
- Exit temperature of 298 ˚C; and
- Two discharge vertical stacks (each) of:
  - Stack height of 21.3 m; and
  - Stack diameter of 1.83 m.

Figure 3 Rolls Royce Trent 60 Gas Turbine

Figure 4 MAN 20V35/44 SG Reciprocating Engine

2.3 Construction Activities

2.3.1 Overview

Subject to statutory approvals, construction activities will commence during the first quarter of 2014.

Construction works will take place largely between 6am to 6pm, with construction workers operating on 12 hour rotating shifts. Administration and management personnel will work a standard 5 x 2 day roster. Occasional night works may be required, for example for concrete pours during hotter months, or to catch up on schedule delays.

Construction works will include the following:

- demolition and disposal of existing process plant and other facilities such as the gate house;
- construction of temporary facilities (i.e. lay down areas, offices, workshops, etc);
- construction camp;
- on site concrete batch plant/s;
- administration and plant site buildings including:
  - mine and plant workshops, warehouses and maintenance facilities;
  - offices, medical facilities and training facilities;
  - security gate house, weighbridge etc;
  - crib room and ablutions;
  - laboratory.
- ore processing plant;
- power station;
- water treatment plant (WTP);
- sludge disposal cell and equalisation pond;
- site roads;
- pumps and pipelines; and
- new sumps, decant towers, decant ponds, collection ditches and diversions.

In addition, associated with ongoing operations the following activities will progressively occur:

- raising of TSF1 from 16 m in height to approximately 34 m in height in six phases;
- construction of TSF2 to 60 m in height over four stages;
- increase in the height of the existing waste rock dump from 24 m to approximately 350 m;
- development of a clay borrow area(s);
- construction of LGO stockpile, collection ditch and lined sump;
- construction of water treatment wetlands; and
- potential construction of a re-aligned access road.

2.3.2 Construction Equipment

The Project will use standard construction machinery, general trade equipment and specialised equipment as required. The indicative number and type of construction equipment required is shown in Table 2.

Plant, equipment and construction materials will be transported to the site by road. Transportation vehicles will be a combination of standard and oversize loads. Larger plant and equipment that cannot be assembled on-site will be transported under appropriate permits.

Any imports via the Port of Darwin will use existing freight receiving and staging areas. Trucking numbers will be established by contractors involved in the construction phase.

Table 2 Indicative Construction Equipment

Equipment	Indicative Number
Scraper/Roller 11T	4
Excavator	4
Front-end loader	6
Grader	2
Crane	6
Water tanker	2
Concrete trucks / pumps	6
Concrete batch plant	1
Dozer D8	2
Dozer D7	1
Rear Dumps or Highway	10

3. Existing Noise Environment

3.1 Sensitive Receptors

The Project is located within a predominantly rural area.

Aerial photography and a site visit in May 2011 were used to determine the proximity of the closest sensitive receptors.

The community of Werenbun is the closest human sensitive receptor location to the mine. Werenbun is approximately 4 km to the southeast of the mine site entry and 7 to 10 km from mine site facilities, and is accessed off Edith Falls Road. In the community of Werenbun there are about 10 houses, 30 people and an open undercover area used as a community school by the NT School of the Air.

Parts of the mine lease and surrounding area supports populations of Gouldian finch, a species protected under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. This species has the potential to be affected by noise and vibration from the Project.

3.2 Existing Noise Sources

Noise sources in the subject area include:

- Traffic noise from the Stuart Highway;
- Rail noise from Adelaide-Darwin rail line; and
- Natural noise from wind, insects and other animals.

3.3 Noise Monitoring Methodology

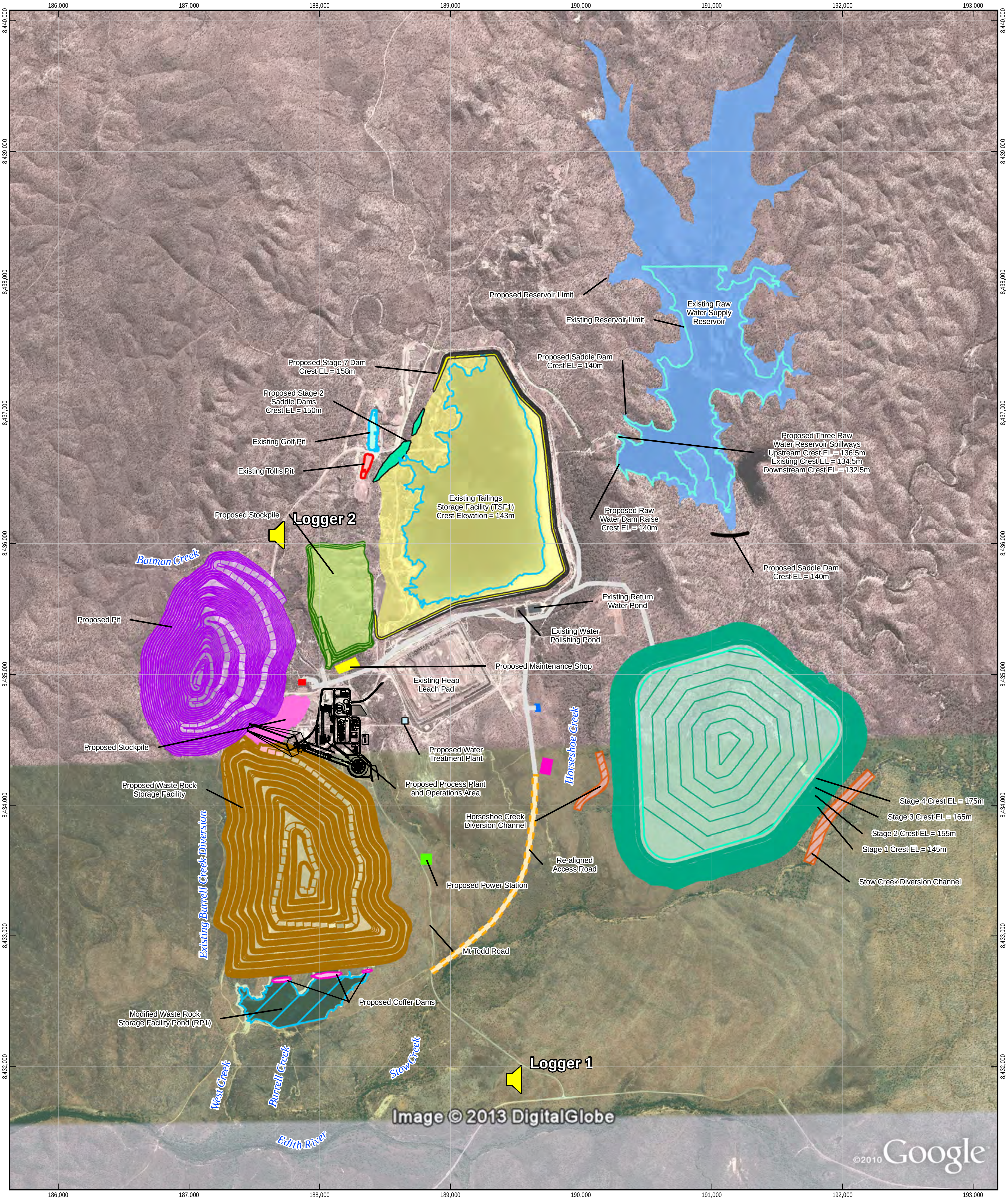
Attended and unattended noise monitoring was conducted in the area surrounding the proposed mine site. The purpose of noise monitoring was to determine the existing noise levels in the area to provide a baseline and assist in setting operational noise goals for the Project.

All sampling activities were undertaken with consideration to the specifications outlined in Australian Standard AS1055 '*Description and Measurement of Environmental Noise'* and, in the absence of relevant NT noise policies/standards, with consideration to the NSW INP (EPA, 2000).

Long-term unattended noise monitoring took place between 3rd May 2011 and 13th May 2011. Monitoring occurred at the mine site as shown in Figure 5.

Two noise loggers were located in areas that are considered representative of the local background noise levels, including the community of Werenbun. Monitoring locations were also chosen as being a safe and secure place for staff and unattended equipment, minimising the risk of theft, vandalism, or damage by natural causes. Land access permission was also a factor that contributed to the final selection of the locations. Two noise loggers were used to gain a wider appreciation of noise levels in the area and also in case one noise logger failed. Attended monitoring was also completed at these locations to better understand the noise sources contributing to overall existing noise levels.

Weather data was obtained from the Bureau of Meteorology automated weather station at RAAF Base Tindal (AWS site 014932), situated approximately 55km southeast of the mine site. This data is considered adequate for the purpose of filtering high wind events and rainfall from the noise data set.



LEGEND

Noise Monitoring Locations	Proposed Maintenance Shop	ANFO Facility	TSF1 Contours	Low Grade Ore Stockpile	Batman Pit Contours (Year 12)	Waste Rock Dump Footprint (Year 10)
Process Plant	Power Plant	Explosives Magazine	TSF1 Existing Water Body	TSF2 Impounded Surface Area (Year 12)	Proposed Saddle Dam (Raw Water Dam)	Stockpile
Golf Pit	Proposed Haul Road	Diversion Channels	Proposed Saddle Dam	TSF2 Contours (Year 12)	Retention Pond 1	
Tollis Pit	Re-aligned Access Road	Raw Water Dam Existing Water Body	TSF1	TSF2 Footprint (Year 12)	Batman Pit Footprint (Year 12)	
Fuel Bays	Coffer Dams	Indicative Raw Water Dam	Low Grade Ore Stockpile Contours	Water Treatment Plant	Waste Rock Dump Contours (Year 10)	

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number | 43-21801
Revision | 1
Date | 07 Jun 2013

Noise Monitoring Locations

Figure 5

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_402.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013).
GHD - Creek Names, Noise Monitoring Locations (2011). Created by: CM

3.4 Unattended Noise Monitoring Results

Two RION NL-21 sound level loggers were used for unattended noise monitoring. The loggers are capable of measuring continuous sound pressure levels and able to record L_{A90}, L_{A10}, L_{Aeq} and L_{Amax} noise descriptors. The instruments were programmed to accumulate environmental noise data continuously over sampling periods of 15 minutes for the entire monitoring period. Noise descriptors reported in this chapter, in dB(A), include L_{A90} and L_{Aeq} which are representative of background noise levels and ambient noise levels for the period of measurement respectively.

The loggers were calibrated with a sound pressure level of 94dB at 1kHz using a RION NC-73 sound level calibrator (serial number 10530430) prior to deployment. At completion of the monitoring period, the loggers were retrieved and calibration was rechecked. The difference was less than +/- 0.5dB. Data collected by the loggers was downloaded and analysed, and any invalid data removed. Invalid data generally refers to periods of time where average wind speeds were greater than 5m/s, when rainfall occurred, or for when anomalous noise levels occurred.

Table 3 provides the details of each noise logger. Photos of the noise monitoring locations are presented in Figure 6 and Figure 7.

Table 3 Unattended Noise Logger Details

Noise logger	Logger 1	Logger 2
Monitoring Location	Mine Site Entry (Near Edith Falls Road)	Mine Site West (Near Batman Creek Crossing)
Logger Serial No.	01277353	01043718
Measurement Started	3/5/11 12:15	3/5/11 14:45
Measurement Ceased	13/5/11 11:45	13/5/11 09:00
Pre-measurement Calibration	94.0 dB(A)	93.9 dB(A)
Post-measurement Calibration	93.6	93.4
Freq. Weighting	A	A
Time response	Fast	Fast

Figure 6 Noise Logger 1 – Southern Side of Mine Site

Figure 7 Noise Logger 2 – Western Side of Mine Site

Table 4 and Table 5 present a summary of the long-term noise monitoring data. Statistical noise results are also presented in graphical format in Appendix A.

Table 4 Summary of Noise Monitoring Results – Logger 1

Logger	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Tuesday 3 May 2011	24	24	24	42	41	40
Wednesday 4 May 2011	-	27	22	-	41	41
Thursday 5 May 2011	26	26	21	43	43	39
Friday 6 May 2011	24	26	22	43	45	41
Saturday 7 May 2011	22	27	22	40	44	42
Sunday 8 May 2011	22	26	22	40	39	37
Monday 9 May 2011	24	24	25	42	38	37
Tuesday 10 May 2011	-	23	23	-	38	39
Wednesday 11 May 2011	-	24	26	-	34	38
Thursday 12 May 2011	-	23	20	-	38	37
RBL and L_{eq} Overall	**24**	**25**	**22**	**42**	**41**	**39**

Note: '-' refers to invalid data that has been excluded from the data set.

Table 5 Summary of Noise Monitoring Results – Logger 2

Logger	Background L_{A90} dB(A)			Ambient L_{Aeq} dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Tuesday 3 May 2011	25	23	24	40	48	44
Wednesday 4 May 2011	24	24	20	-	43	34
Thursday 5 May 2011	21	21	19	41	40	28
Friday 6 May 2011	21	20	20	35	47	42
Saturday 7 May 2011	20	27	20	34	46	34
Sunday 8 May 2011	21	22	24	33	46	42
Monday 9 May 2011	-	21	27	-	42	42
Tuesday 10 May 2011	-	25	20	-	42	37
Wednesday 11 May 2011	20	22	19	40	34	41
Thursday 12 May 2011	22	18	17	41	36	32
RBL and Leq Overall	**21**	**22**	**20**	**38**	**45**	**40**

Note: '-' refers to invalid data that has been excluded from the data set.

3.5 Attended Noise Monitoring Results

Attended noise monitoring was conducted over 15 minute periods at each of the long term monitoring locations. Attended measurements were undertaken using a Bruel and Kjaer 2250 sound level meter (SLM) (serial number 2449936). This SLM is capable of measuring continuous sound pressure levels and is able to record L_{Amin}, L_{A90}, L_{A10}, L_{Amax} and L_{Aeq} noise descriptors. Calibration was checked prior to the commencement of measurements and at completion of the measurements. The difference was less than +/- 0.5dB. Details of the existing noise environment including noise sources and ambient/background noise levels were recorded during these monitoring periods. Photos of attended noise monitoring locations are presented in Figure 8.

Figure 8 Receptor 01 – Werenbun

The results of attended monitoring are shown in Table 6.

Table 6 Attended Noise Measurements

Site Location	Time	L_{A90}	L_{Aeq}	L_{A10}	Comments
Mine Site 2 – Batman Creek	3/05/2011 11:44	23.3	32.1	35.7	Low background noise, some noise from birds and gusts of wind. Wind gusts up to 35dB(A), lulls in wind around 25dB(A). Drilling or any site activities not audible
East of Tailings Dam	3/05/2011 12:19	33.9	47.3	47.7	Strong gusty winds up to 50dB(A). Wind blowing from the south, birds.
Werenbun Community	3/05/2011 14:20	40.5	49.2	48.8	Strong wind the entire monitoring period, and bird noise. No other noise sources identified.
Werenbun community entry	3/05/2011 22:07	21.7	26.3	27.3	Located at the entry to the Werenbun community, approximately 1km from housing. Very low noise levels. Small peaks from insects at 5kHz.
Mine Site 2 – Batman Creek	3/05/2011 22:49	42.6	44.3	45.5	No wind, insects in 5 – 6.3kHz range dominant the entire measurement ~ 40 – 45dB(A). Drilling noise just audible (other site investigations), however below background.
Mine Site 1 – Site Entry	3/05/2011 23:28	30.0	35.8	40.6	No wind, insect noise dominant during measurement (6.3KHz).
Werenbun community entry	4/05/2011 8:45	34.2	44.5	44.4	Wind related noise, wind gusty at times. Birds calling, no traffic. In calmer periods noise level approximately 30dB(A).
Mine Site 2 – Batman Creek	4/05/2011 9:27	34.5	38.8	41.8	High winds the entire monitoring period, some birds. Drilling noise not audible.
Mine Site 1 – Site Entry	4/05/2011 11:16	38.7	46.6	49.0	High wind noise, up to 50dB(A). In calmer periods, noise levels approximately 35dB(A).

3.6 Meteorology

Mt Todd mine site is classified as having a tropical savannah climate being located between the Inter-Tropical Convergence Zone (ITCZ) and the subtropical high. There is a distinct wet and dry season with little variation in temperature throughout the year. Inland regions experience hot and dry conditions outside the wet season (http://bom.gov.au/climate/environ/other/koppen_explain.shtml).

Annual Wind Climate

The annual wind rose for RAAF Base Tindal (Figure 9) shows the prevailing wind to be from the southeast quadrant. Winds from the southeast comprise 18% of annual winds, followed in frequency by winds from the east-southeast (15.5%). This pattern reflects the easterly trade winds experienced at mid-latitudes.

The incidence of light winds (less than 2m/s) is also highest from the southeast, comprising of 7.5%. The annual average wind speed at the RAAF Base Tindal AWS is 2.8m/s.

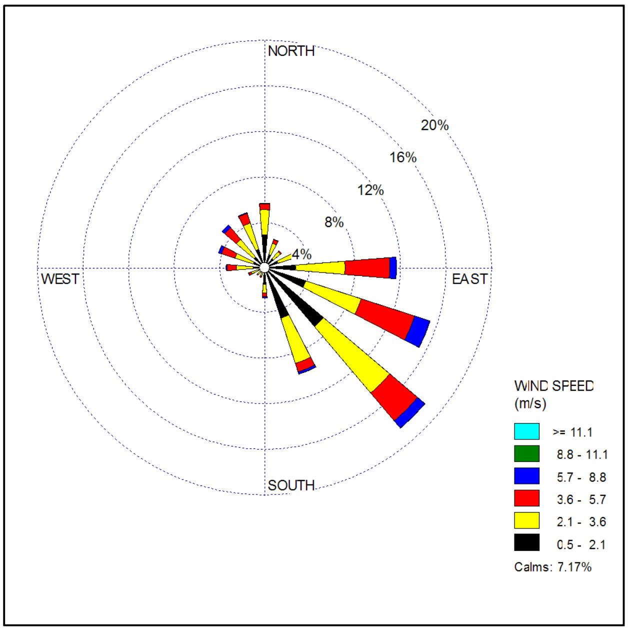


Figure 9 Annual Wind Rose for RAAF Base Tindal

Seasonal Wind Climate

Figure 10 shows that there is a clear distinction in incident wind direction between the wet and dry season. The wet season is determined to begin in December and end in March. During the wet season the Australian Monsoon dominates synoptic flows with the prevailing wind from the northwest with an average wind speed of 2.7m/s. Synoptic flows during the dry season are characterised by the easterly Trade Winds with a greater incidence from the southeast and an average wind speed of 2.9m/s.

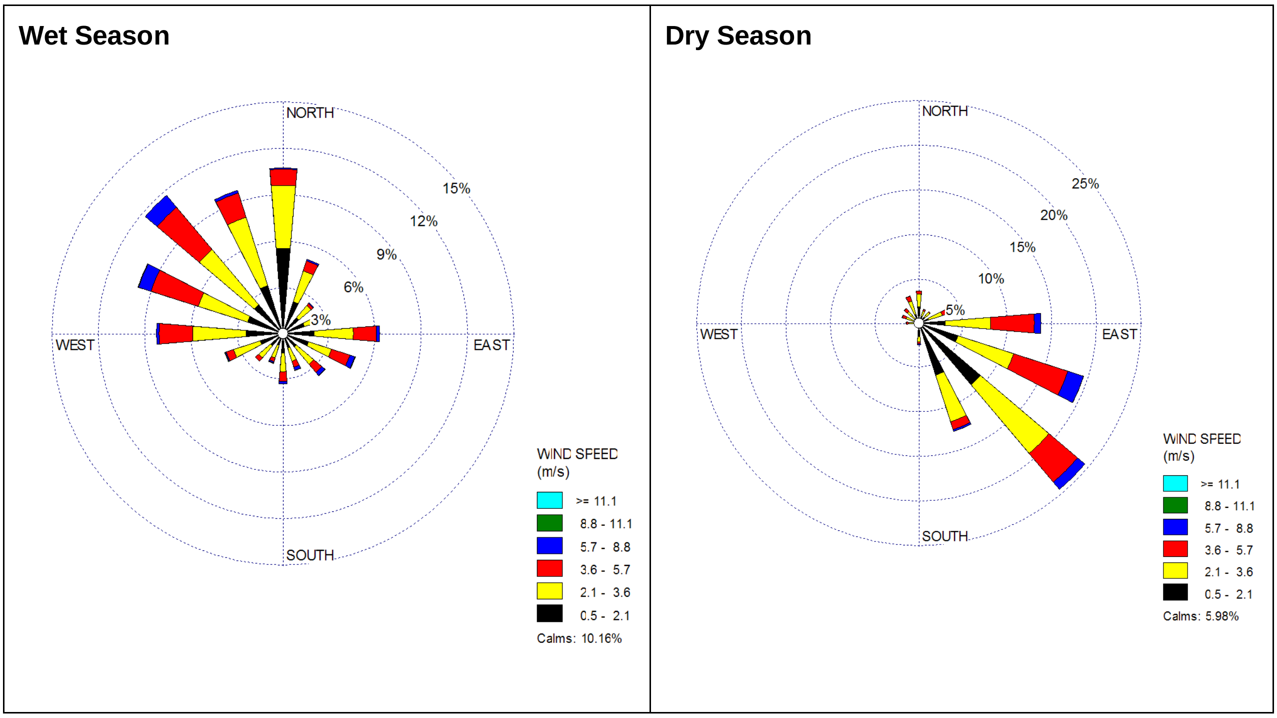


Figure 10 Seasonal Wind Roses for RAAF Base Tindal

The INP states that wind effects need to be assessed where wind is a feature of the area. Based on analysis of meteorological data for the mine, wind is considered to be a feature where-source-to-receiver wind speeds of 3m/s or below occur for 30% of the time or more in any assessment period (day, evening, night) in any season. Therefore, this assessment has included consideration of mine noise enhancement due to wind effects.

Atmospheric Stability

Atmospheric stability can influence noise propagation. The Pasquill/Gifford scale of atmospheric stability consists of six stability classes. A, B and C represent strongly, moderately and slightly unstable atmospheres respectively.

Category D classifies a neutral atmosphere and E and F slightly and moderately stable atmospheres respectively. Stable conditions will generally develop at night, under clear skies and weak gradient winds. Such conditions are often coupled with ground based, radiation forced temperature inversions, sometimes with fog, mist or frost. Temperature inversion will cause sound wanes to be reflected back towards the ground, thereby increasing noise levels compared to neutral conditions. It is commonly stable conditions that result in off-site noise impact at a maximum range.

The annual stability rose for the data set is depicted in Figure 11. The following features are portrayed:

- Stability class D (neutral) is the most frequently experienced atmospheric condition, present 38% of the time;
- Stable classes E & F combined comprise 34% of atmospheric condition; and
- The highest incidence of E & F conditions are seen from the southeast.

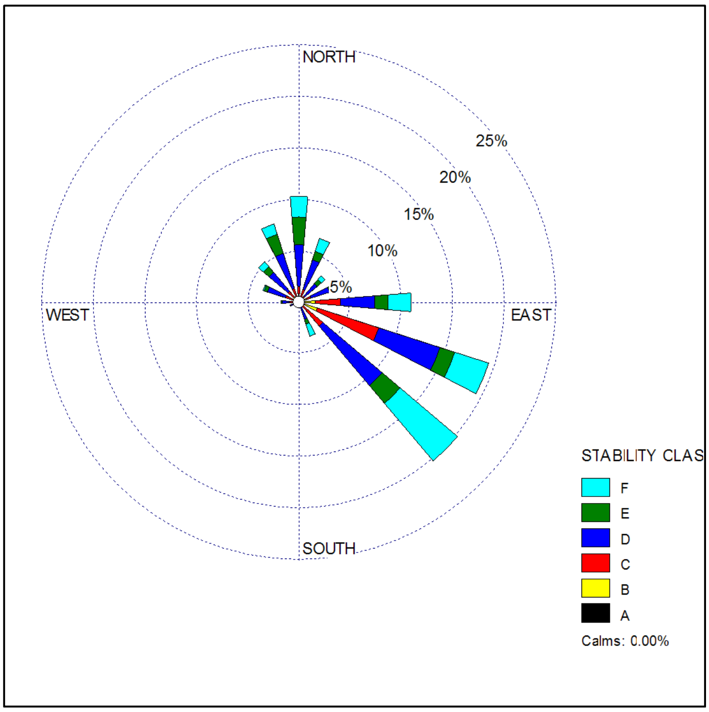


Figure 11 Annual Stability Rose - Mine site

When season is taken into account, it is seen that the highest incidence of stable conditions corresponds to the change in prevailing wind (Figure 12).

Dry Season | **Wet Season**

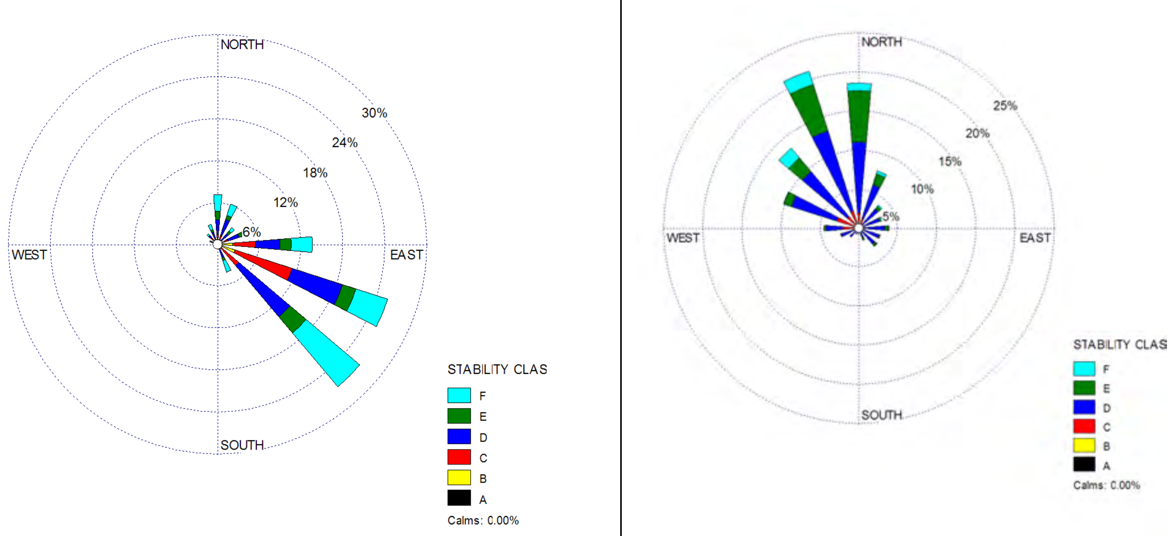


Figure 12 Seasonal Stability Roses – Mine Site

As per the INP, assessment of impacts is confined to the night noise assessment period (10pm to 7am), as this is the time likely to have the greatest impact - that is, when temperature inversions usually occur and disturbance to sleep is possible.

The INP states that an occurrence of 30% of the total night-time during winter (June, July and August) is selected as representing a significant noise impact warranting further assessment.

Based on analysis of meteorological data for the mine, F class atmospheric conditions occur for more than 30% of the total winter night-time. Therefore, this assessment has included consideration of mine noise enhancement due to temperature inversion.

4. Noise and Vibration Criteria

4.1 Operational Noise Criteria

The *Waste Management and Pollution Control Act* 1998 arose as the initial action in the development of a Strategy for Waste Management and Pollution Control in the Northern Territory that began in 1995.

The Act has no provision for the assessment criteria for operational noise and vibration. There are no other relevant Northern Territory guidelines and criteria for operational noise or vibration. Therefore, operational noise criteria applicable to site noise sources were determined with consideration to the NSW INP (EPA, 2000). The policy is specifically aimed at assessing noise from industrial noise sources scheduled under the NSW *Protection of the Environment Operations Act 1997*. It is typically used as a guide by NSW Environment Protection Authority (EPA) officers for setting statutory limits in licences for these sources. The policy is designed for large and complex industrial sources and specifies substantial monitoring and assessment procedures. The INP is typically the preferred noise guideline in the absence of other noise policies and guidelines. The INP provides guidance on the assessment of operational noise impacts. The guidelines include Intrusive and Amenity criteria designed to protect receptors from noise significantly louder than the background level and to limit the total noise level from all sources near a sensitive receptor.

Intrusive noise limits set by the INP control the relative audibility of operational noise compared to the background level. The amenity criteria limit the total level of extraneous noise. Both sets of criteria are calculated and the more stringent of the two in each time period applies with consideration to the Office of Environment and Heritage (OEH) Application Notes pertaining to Section 2.4 of the INP. Table 2.2 in the INP provides modifications to the amenity criteria for existing levels of industrial noise.

Attended observations noted that existing levels of industrial noise in the area are not a contributor to the existing ambient noise level in the vicinity of the development. Therefore the amenity noise criteria do not require adjustment.

The amenity criteria are determined based on the overall acoustic characteristics of the receptor area, and the existing level of noise excluding other noises that are uncharacteristic of the usual noise environment. Residential receptor areas are characterised into ‘urban’, ‘suburban’, ‘rural’ or other categories based on land uses, the existing level of noise from industry, commerce, and road traffic. The nearest residential receptors to this development were classified as rural.

The recorded noise data from Logger 2 exhibited slightly lower values than Logger 1, possibly due to being located within the mine site within a more sparsely vegetated area than Logger 1. Results from both loggers were less than 30dB(A), and the NSW INP states that where the background level is found to be less than 30dB(A) then it is set to 30dB(A).

The project specific noise levels for the proposed mine at identified sensitive receptors at Werenbun are provided in Table 7.

The above levels apply at the boundary of the most affected residences or within 30m from the residence where the property boundary is more than 30m from the residence.

Table 7 Project Specific Noise Levels – Werenbun Receptors

Criterion	Nearest residential receptors		
	Day 7am to 6pm	Evening 6pm to 10pm	Night 10pm to 7am
A: Rating background level	24 $L_{A90(day)}$	25 $L_{A90(evening)}$	22 $L_{A90(night)}$
B: Intrusiveness criteria (A + 5dB)	35 $L_{Aeq(15min)}$	35 $L_{Aeq(15min)}$	35 $L_{Aeq(15min)}$
C: Rural amenity criteria (Table 2.1 INP)	50 $L_{Aeq(day)}$	45 $L_{Aeq(evening)}$	40 $L_{Aeq(night)}$
D: Amenity criteria: (INP Table 2.2 Adjusted)	-	-	-
Project specific noise level (Page 21 INP)	35 $L_{Aeq(15min)}$	35 $L_{Aeq(15min)}$	35 $L_{Aeq(15min)}$

Note: The NSW INP states where the rating background level is found to be less than 30 dB(A), then it is set to 30 dB(A).

(-) denotes not applicable since there is no existing industrial noise at the monitoring locations.

4.1.1 Low Frequency Noise

The INP is considered to address noise sources with inherent dominant infrasound or (very) low frequency noise characteristics. The proposed power station at the mine site has the potential to generate low frequency noise components below 200Hz.

Where a noise source contains certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level. Table 4.1 in the INP sets out the corrections to be applied for tonal, impulsive, intermittent and low-frequency noise. The corrections specified are to be added to the measured or predicted noise levels at the receiver before comparison with the criteria. Correction of 5dB for low frequency noise is to be applied if the difference between the measurements of C-weighted and A-weighted levels over the same period is 15dB or more.

4.2 Construction Noise Criteria

Construction noise emitted from the Project is assessed with consideration to the Northern Territory Environment Protection Authority (NT EPA) *Noise guidelines for development sites in the Northern Territory* (NT EPA 2013). The NT EPA recommends standard hours for construction activity as detailed in Table 8.

Extended working hours would be required on some week nights, particularly for concrete pours during the hotter months, or to catch up on schedule delays. However, given the location of the mine site and the large distance between sources and receptors, this is not expected to be an issue.

The need for extended working hours will be determined during detailed design and during the construction period.

It is unlikely that blasting will be required during construction. This will be confirmed on finalisation of the relevant geotechnical studies.

Table 8 NT EPA Acceptable Construction Times

Work type	Acceptable construction times
Normal construction	Monday to Saturday: 7am to 7pm. Sunday or Public Holiday: 9am to 6pm.

The NT EPA provides a noise limit for construction noise levels at residential receptors/residential area uses during the acceptable construction times. These noise limits are calculated based on the adopted rating background level at nearby residential locations, as shown in Table 9.

Table 9 NT EPA Construction Noise Criteria during Acceptable Construction Times

Designation Area	Construction Noise Limit $L_{Aeq(15\ min)}$
Residential uses areas	Background noise + 5dB(A)

The above levels apply within 15 metres of a Noise Sensitive Receiver (NSR) or at or on the boundary of the NSR (adjusted for tonality, impulsiveness, and/or modulation) during acceptable construction times.

"*NT EPA regards noise emitted from a development site may be considered an environmental nuisance or pollution if:*

a) the construction activity is conducted;

i. outside the hours of 7am and 7pm Monday to Saturday; or

ii. on a Sunday or public holiday outside the hours of 9am and 6pm; and

b) the construction activity was not carried out in accordance 'AS 2436 Guide to Noise Control on Construction, Maintenance and Demolition Sites'; and

c) 48-hours notice was not given to the occupiers of all noise-receiving premises where noise levels for the development site are likely to be of concern including;

i. a description of proposed construction activity likely to cause nuisance;

ii. the time(s) and date(s) for the construction activity; and

iii. the name and phone number of the person to whom a complaint may be made about noise emissions from the site;

OR

d) the activity was not carried out in accordance with a Noise Management Plan registered with NT EPA."

Where the above construction noise limit is exceeded, all feasible and reasonable work practices to minimise noise should be applied and all potentially impacted residents should be informed of the nature of the works, expected noise levels, duration of works and a method of contact. This would include the preparation Noise Management Plan (NMP) provided to NT EPA, which is discussed in Section 6 of this report.

Based on the above and the RBL determined from site monitoring (see Section 3), construction noise goals were derived based on Logger 1 location, as shown in Table 10.

Table 10 Construction Noise Goals dB(A) L_{Aeq}

Monitor ID	Within Acceptable Construction Times
L1 (Logger 1)	29

4.3 NSW Sleep Disturbance Criteria

The NSW OEH, Noise Guide for Local Government (NGLG) provides guidelines for assessing sleep disturbance from short-term noise events. To assess potential disturbance during night-time hours (10pm to 7am), Section 2.4.5 of the NGLG recommends that $L_{A1\ (1min)}$ levels outside a bedroom window should not exceed the background level by more than 15dB. Based on a measured background noise level of 22dB(A) (refer to Section 3.4), the sleep disturbance noise goal for the night-time period is $L_{A1\ (1min)}$ 37dB(A) for all the surrounding residential receptors.

4.4 Vibration Criteria

4.4.1 Human comfort vibration criteria

In the absence of any Northern Territory or Australian guidelines relating to human comfort criteria for vibration, criteria have been adopted with consideration to the British Standard 6472 – 2008, *Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting (BS 6472-1:2008)*, which are recognised as the preferred standard for assessing the "human comfort criteria" for residential building types.

Typically, mine activities generate ground vibration of an intermittent nature. Under BS 6472-1:2008, intermittent vibration is assessed using the vibration dose value (VDV). Table 11 includes acceptable values of vibration dose for residential receptors for daytime and night-time periods.

Table 11 Vibration Dose Value Ranges and Probabilities for Adverse Comment to Intermittent Vibration ($m/s^{1.75}$)

Location	Low probability of adverse comment[1]	Adverse comment possible	Adverse comment probable[2]
Residential buildings 16 hour day (0700 – 2300 hrs)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hour night (2300 to 0700 hrs)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

1 Below these ranges adverse comment is not expected.
2 Above these ranges adverse comment is very likely.

These values represent the best judgement available at the time the standard was published and may be used for both vertical and horizontal vibration, providing that they are correctly weighted. Because there is a range of values for each category, it is clear that the judgement can never be precise.

Whilst the assessment of response to vibration in BS 6472-1:2008 is based on VDV and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of peak particle velocity (PPV), since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels that are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in British Standard 5228-2:2009 *Code of practice for noise and vibration on construction and open sites – Part 2: Vibration* (BS 5228-2:2009) as shown below in Table 12.

Table 12 Guidance on the Effects of Vibration Levels

Approximate Vibration Level	Degree of Perception
0.14mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.30mm/s	Vibration might be just perceptible in residential environments.
1.00mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10.00mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

4.4.2 Structural damage vibration criteria

There is no Australian Standard that sets the criteria for the assessment of building damage caused by vibration. Guidance limiting vibration is attained by reference to German Standard *DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures* (DIN 4150-3).

Table 8 of DIN 4150-3 presents guideline values for the maximum absolute value of the velocity *"…at the foundation of various types of building. Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible*."

Measured values exceeding those listed in Table 13 "*…does not necessarily lead to damage; should they be significantly exceeded, however, further investigations are necessary.*"

The vibration criteria presented in this standard exceed the human comfort criteria presented above. Therefore, as indicated above, the human comfort criteria should be the over-riding criteria for the assessment of any vibration.

Table 13 Guideline Values for Short Term Vibration on Structures

Line	Type of Structure	Guideline Values for Velocity, (mm/s)		
		1Hz to 10Hz	10Hz to 50Hz	50Hz to 100Hz[a]
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

[a] Where frequencies are above 100 Hz the values given in this column may be used as minimum values.

4.5 Blasting

OEH refers to Australian and New Zealand Environment and Conservation Council (ANZECC) *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* (1990) when dealing with potential blasting noise and vibration. This guideline recommends the noise and vibration limits shown in Table 14.

Table 14 Recommended ANZECC 1990 Blasting Limits

Airblast Overpressure	Ground Vibration
115dB(lin) peak	5mm/s PPV
The level of 115dB(lin) may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 120dB(lin) peak.	The level of 5mm/s may be exceeded on up to 5% of the total number of blasts over a period of 12 months, but never over 10mm/s.

ANZECC guideline recommends that blasting should only be permitted during the following hours:

- Monday to Saturday, 9am to 5pm;
- No blasting on Sundays or Public Holidays.

Blasting should generally not take place more than once per day. This requirement does not apply to minor blasts such as clearing crushers, feed chutes, etc (ANZECC 2990).

When considering a time to initiate the blast - weather conditions must be assessed. Generally the atmosphere is most stable early morning and late afternoon due to the absence of direct ground heating from the sun (Queensland Guidance Note QGN 20 v 3, DEEDE, 2011).

4.6 Road Traffic Noise Criteria

Stuart Highway is the only government controlled road potentially affected by the Project. It is not planned for redevelopment or upgrade. The developer is solely responsible for managing traffic noise impacts on sensitive receptors.

The former Northern Territory Department of Planning and Infrastructure (DPI) *Road Traffic Noise on NT Government Controlled Roads* Policy (DPI 2006) provides guidance on efficient road transport infrastructure and controlling the adverse effects of road traffic noise on adjacent land uses. The requirements for proposed developments are summarised in Table 15.

Table 15 NT Criterion for Road Traffic Noise

Road Category	Type of project/land use
Road Traffic Noise on NT Government Controlled Roads Policy (2006)	**Existing Road – Unplanned Significant Development** *Existing Residential* Where there is both a predicted increase in noise level of >5 dB(A) and the predicted noise target level is >$L_{A10\ 18hour}$ 68 dB(A), target $L_{A10\ 18hour}$ 68 dB(A). *Existing Noise Sensitive** Where there is both a predicted increase in noise level >5 dB(A) and the predicted noise level is > $L_{A10\ 18hour}$ 63 dB(A), target $L_{A10\ 18hour}$ 63 dB(A). *Future Residential and Noise – Sensitive* Responsibility for noise management of developments undertaken adjacent to an existing or planned future road rests with the proponent (private or government agency).

**Existing noise sensitive* – includes aged care, nursing homes and may include schools, libraries and hospitals. Commercial accommodation facilities relying on passing trade are not considered as noise sensitive developments under this policy.

5. Impact Assessment

5.1 Construction Noise Assessment

Typical noise levels produced by construction plant anticipated to be used on site were sourced from Australian Standard AS 2436 – 2010 *Guide to Noise Control on Construction, Maintenance and Demolition Sites* and from GHD's internal database.

Indicative acoustic modelling was undertaken using Computer Aided Noise Abatement (CadnaA) V4.3 to provide preliminary prediction on the effects of construction-related noise from the proposed development.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. For the purpose of indicative construction noise modelling, CadnaA calculates environmental noise propagation according to ISO 9613-2 "Acoustics – Attenuation of sound during propagation outdoors". Propagation calculations take into account ground topography, sound intensity losses due to hemispherical spreading, atmospheric absorption and soft soil ground absorption. Additional factosr such as directivity was not considered in the noise calculations. This provides a measure of conservatism.

The ISO 9613 algorithms also take into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm night or 'downwind' conditions which are favourable to sound propagation. As a result, predicted received noise levels are expected to overstate actual received levels and thus provide a measure of conservatism.

Table 16 presents the sound power level associated with the indicative construction equipment detailed in Section 2.3.2,

Table 16 Indicative Construction Equipment Sound Power Levels SWL (re: 20 µPa)

Plant Item	Number of Items Used	dB(A) L_w Per Item
Crane	6	110
Concrete truck /pump	6	109
Dump truck	10	108
Water tanker	2	109
Scraper/Roller 11T	4	114
Excavator	4	107
Front-end Loader	6	113
Grader	2	110
Dozer D8	2	107
Dozer D7	1	113
Concrete batch plant	1	113

Construction equipment was modelled assuming simultaneous operation at full capacity in the proximity of ore processing plant areas. Results are detailed in Table 17.

Table 17 Predicted Construction Noise Levels at Nearby Sensitive Receiver

Sensitive Receiver Location	Predicted Noise Levels dB(A) L_{Aeq}
Werenbun	24

The distance between the proposed construction works and the identified receptors at Werenbun will be in the order of 7km at the minimum. The predicted results shown in the above table suggest that all construction activity noise will be under the daytime construction noise criteria of 29dB(A).

5.1.1 Sleep Disturbance

The Project criteria for night-time sleep disturbance of 37dB(A) $L_{A1,1min}$ external to the dwelling is predicted to be met at all receptors.

5.2 Construction Vibration

Some construction equipment can generate high vibration levels and need to be assessed to minimise potential adverse impacts on the surrounding residential receptors.

Energy from construction equipment is transmitted into the ground and transformed into vibrations, which attenuate with distance. The magnitude and attenuation of ground vibration is dependent on:

- The efficiency of the energy transfer mechanism of the equipment (i.e., impulsive; reciprocating, rolling or rotating equipment);
- The frequency content;
- The impact medium stiffness;
- The type of wave (surface or body); and
- The ground type and topography.

The above factors cause inherent variability in ground vibration predictions in the absence of site-specific measurement data. The NSW RTA Environmental Noise Management Manual (RTA, 2001) provides typical construction equipment ground vibration levels at 10m. The rate of vibration attenuation can be calculated from the following regression analysis formula:

$V = kD^{-n}$ where

V = PPV

D = Distance

n = attenuation exponent. The value of n generally lies between 1 and 2 with a relatively common value of 1.5[1].

k = Velocity (PPV) at D=1 unit of distance

[1] Construction Vibrations: State of the Art (Wiss, 1981)

The predicted ground vibrations at various distances are shown in Table 18 for typical construction equipment.

Table 18 Predicted Construction Equipment Vibration Levels (mm/s PPV)

Plant Item[2]	Human Perception Preferred Criteria *(Maximum Criteria)*		Predicted Ground Vibration				
	Day	Night	10m	20m	50m	100m	300m
15t roller	0.28 *(0.56)*	0.2 *(0.4)*	7 to 8	3.8	1.5	0.8	<0.1
Dozer	0.28 *(0.56)*	0.2 *(0.4)*	2.5 to 4	1.6	0.7	0.3	<0.1
Excavator	0.28 *(0.56)*	0.2 *(0.4)*	3	1	0.3	0.1	<0.1
Grader	0.28 *(0.56)*	0.2 *(0.4)*	3	1	0.3	0.1	<0.1

Given the distance to the nearest receptor from the mine site is approximately 7km, construction vibration will not exceed the human perception criteria and is not discussed further in this assessment.

5.3 Operational Noise Assessment

5.3.1 Noise Modelling Methodology

Acoustic modelling was undertaken using CadnaA V4.3 noise modelling software to predict the effects of industrial noise generated by the proposed mine. CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to the CONCAWE noise prediction method. Terrain topography, ground absorption, atmospheric absorption and relevant shielding objects are taken into account in the calculations.

CONCAWE is a mathematical model developed to predict community noise levels from petrochemical and industrial plant for a range of meteorological conditions. A full description of the mathematical model is provided in the report prepared for the Conservation of Clean Air and Water in Europe *Report No. 4/81 -The propagation of noise from petroleum and petrochemical complexes to neighbouring communities* (CONCAWE, 1981). The CONCAWE prediction method is widely used in Australia for predicting noise impacts of mines, power stations, and other industry.

Note that the assessment has been modelled based on available data. The proposed layouts for the mine and noise generating equipment were based on information provided at the time of the assessment.

Other parameters used in the model are listed in Table 19.

[2] NSW RTA Environment noise management manual, 2001

Table 19 Model Settings

Model Setting				
Industry Algorithm	CONCAWE			
Ground absorption	0.5			
Terrain	5m resolution for the mine site and 50m resolution outside the mine site			
Model Scenarios	Temperature Inversion	Wet Season	Dry Season	Neutral Meteorological Conditions
Temperature (^{o}C)	10	20	10	20
Humidity	50%	80%	50%	80%
Stability Class	F	D	D	D
Wind Speed	2m/s	3m/s	3m/s	0m/s
Wind Direction	315º	315º	135º	0º

5.3.2 Primary Noise Sources

Modelled overall sound power levels for mobile and fixed sources for the proposed mine are summarised in Table 20 and Table 21 respectively. These sound power levels are maximum predicted levels produced when machinery is operating under full load.

Typical mining equipment noise levels have been obtained from noise assessments conducted on similar projects[3] and GHD's noise source database.

In addition to the above, based on manufacturer information, the power station has been modelled to include:

- One (1) Rolls Royce Trent 60 power generation package with a far field noise level (100m from plant) of 65dB(A). For worst-case scenario, the Rolls Royce Trent 60 power generation was modelled as a point source with 10 m high above ground level.
- Two (2) MAN 20V35/44G reciprocating engines with an unsilenced exhaust sound power level of 141dB(A). A silencer has been assumed to be used on the exhaust that provides a minimum attenuation of 25 dB(A). This is considered to be a low level of attenuation and would be the minimum attenuation achieved by using silencers on the facility. The following MAN engines sound data was sourced from the product specification.

[3] Sound power levels sourced from Olympic Dam Expansion Draft EIS (BHP Billiton, 2009), Clermont Coal Project EIS (Rio Tinto, 2004), Cloncurry Copper Project (ASK, 2009), Wandoan Coal Project EIS (PB, 2008), Grosvenor Coal Project EIS (Bridges Acoustics, 2010).

Table 20 Modelled Noise Sources – Primary Mobile Sources

Noise Source	Number of Items Modelled	Sound Power Level (L_w) dB(A)	Modelled Height (m)
Cat D8 Dozer	1	111	3
Cat D9 Dozer	2	111	3
Cat 834 H Dozer	2	115	4
Cat 994 Front End Loader	2	112	4
Cat 16H Grader	2	110	4
Cat 226B Skid Loader	1	105	4
Cat 777B Water Truck	2	115	4
Cat 793C Truck	38	119	4
Cat 785C	4	110	4
Hitachi Ex 5500	4	118	4
Cat 321 DL Excavator	1	113	4
36 Tonne Crane	1	98	4
Atlas Copco Pit Vider 235 blast-hole drills	8	119	4
Atlas Copco 45K rotary drill rig;	1	119	4
Flatbed Truck	1	103	4
60t Haul Truck	1	103	4
ANFO Truck	2	103	4
4WD utes	16	82	1.5
Passenger vans	2	82	1.5
Rock breaker attached to Cat 321DL Excavator	1	118	1
Light Plants	4	90	1

Table 21 Modelled Noise Sources – Fixed Sources

Noise Source	Number of Items Modelled	Sound Power Level (L_W) dB(A)	Modelled Height (m)
Primary Crusher	1	116	2
Secondary Crusher	1	112	2
Screening Plant – Finlay 683	1	111	2
Screening Plant – Finlay 640	1	108	2
Conveyor	1	94 per linear metre	1
Tailings Pumps	2	93	2
HPGR Mills 1	1	118	4
HPGR Mills 2	1	117	4
Reclaimer	1	115	10
Ball Mill	3	117	1
Diesel Generator	1	97	1
Water Treatment Plant	1	85	2

Table 22 MAN Engine Sound Power Level SWL (10^{-12} Watt)

MAN Engine V35/44G	Lw dB(A)	Octave Centre Frequency (Hz)/dB(linear)								Data Source
		63	125	250	500	1000	2000	4000	8000	
Intake	142.7	106.3	105.6	110.7	113.1	134.9	137.2	137.2	133.9	Product Specification
Exhaust (unsilenced)	141	149.8	142.0	137.9	136.5	135.0	133.6	132.2	129.2	Product Specification
Engine noise	113	80.8	93.7	99.6	109.2	107.1	104.8	103.1	96.2	Product Specification

The following assumptions are considered for modelling the MAN engine noise sources:

- It is assumed that the MAN engines were located inside a 5 metre high building, constructed of 0.6 mm thick steel shed with acoustic rating of Rw 24;
- Two MAN exhaust stacks were modelled with stack parameter as detailed in Section 2;
- Note that the MAN engine intakes were modelled unsilenced and as point sources located at a height of 2 metres above ground, within 2 metres from the MAN building. They have been modelled such that they do not have direct line of sight to the Werenbun noise sensitive receiver (i.e. the modelled MAN building as the intervening object between the MAN engine intake and the sensitive receiver). Should the final design of the power station layout does not reflect the above configuration characteristics applied to the noise model, further noise assessment may be required to determine the necessity of noise attenuation at the MAN engine intakes to ensure compliance with the prescribed noise criteria.

Note that HV workshop, pre-leach thickener, etc. are not considered primary noise sources. The noise contribution from these sources to the overall noise level emanating from the mine site would not be considered significant and therefore was not considered in the assessment.

5.3.3 Mine Operation Noise Impact

Due to staging, noise impact will vary over the proposed 13 year life of the mine, depending on where machinery is operating. Areas where these changes will occur are Batman Pit and the waste rock dump. For the noise assessment, a worst case scenario has been modelled, which includes machinery operating in the southern most area of the waste rock dump to represent the latter stage of the mine operation (ultimate waste rock dump boundary). A map showing the worst-case staging for noise impact is presented in Figure 13.

The processing facilities and the power station will operate 24 hours a day, 365 days per year. Prevailing winds during the dry season are from the south-east, which are directed away from the nearest noise sensitive receptors at Werenbun. Prevailing winds during the wet season are from the north west, which are directed toward Werenbun.

Noise propagation modelling has been undertaken with four scenarios:

- Temperature inversion;
- 3m/s wind from the south-east (dry season);
- 3m/s wind from the north-west (wet season) and
- Neutral conditions (no wind).

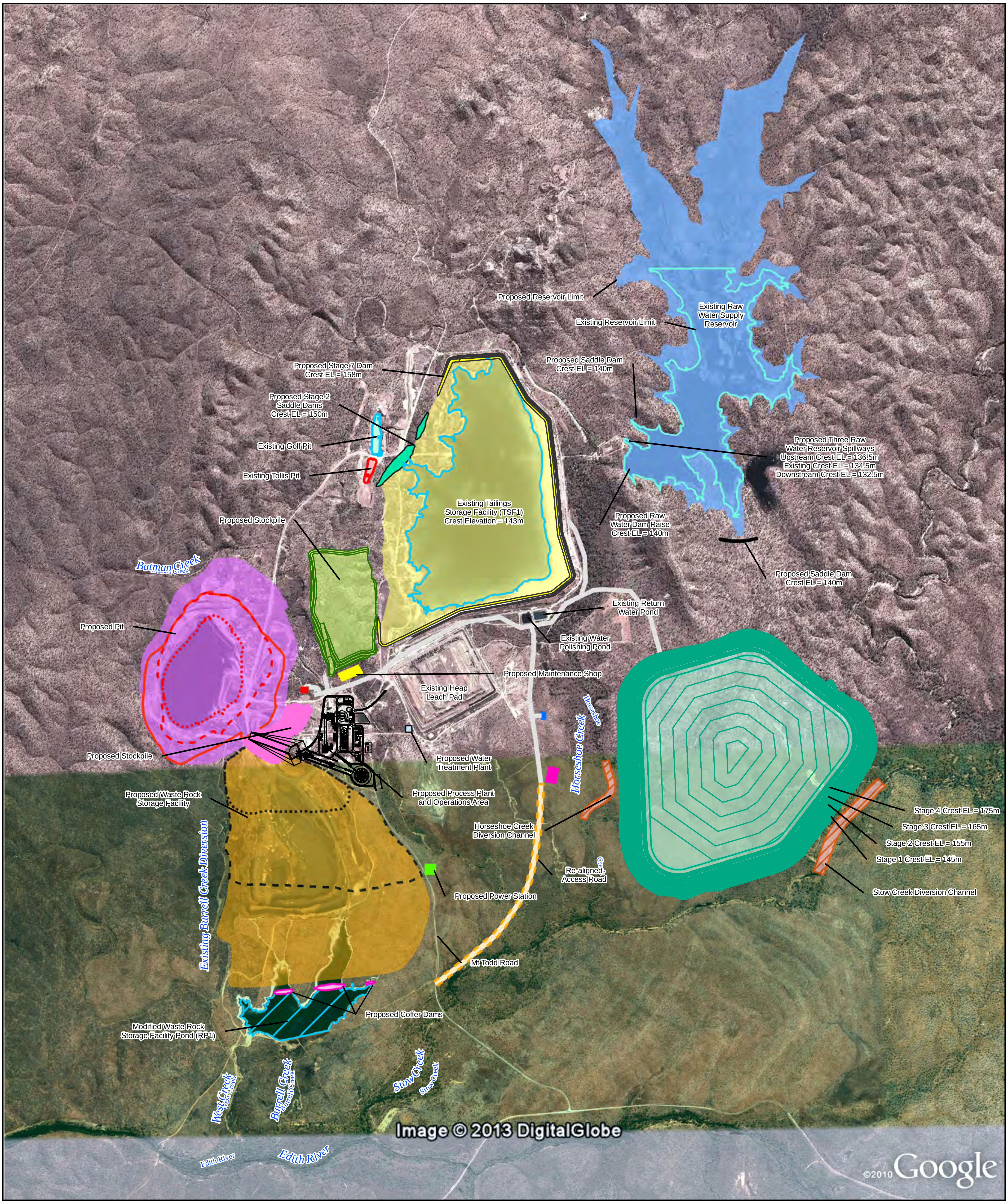
Predicted noise impact at the nearest noise sensitive receptor is summarised in Table 23.

Table 23 Summary of Results dB(A) – 1.5m above Ground Level

Receptor	24-Hours Noise Impact [dB(A) SPL re:20μPa]				Project Specific Noise Goals L_{Aeq} dB(A)
	Temperature Inversion	Dry Season	Wet Season	Neutral Meteorological Conditions	
Werenbun	29	20	30	23	35

The four noise contour scenarios are presented in Figure 14 to Figure 17. The wind assisted conditions during the wet season are presented as the most adverse conditions during operation of the mine. Operational noise levels assessed under all weather conditions are predicted to be below the noise criteria of 35 dB(A) at all times.

Noise model results indicate the predicted low frequency difference for C-weighted and A-weighted noise levels over the same period is less than 15 dB. The correction for low frequency noise, as specified in INP, was not required to be added to the predicted noise levels at the receiver. Even if required, the site noise emissions would still be expected to comply with the relevant noise criteria.



LEGEND

Batman Pit
- Year -1
- Year 1
- Year 3
- Year 5

Waste Rock Dump
- Year 1
- Year 2
- Ultimate Boundary
- Process Plant
- Low Grade Ore Stockpile Contours

- Low Grade Ore Stockpile
- TSF1 Contours
- TSF1 Existing Water Body
- TSF1
- TSF2 Contours (Year 12)
- TSF2 Impounded Surface Area (Year 12)
- TSF2 Footprint (Year 12)
- Golf Pit
- Tollis Pit
- Fuel Bays
- Proposed Maintenance Shop
- Power Plant
- Proposed Haul Road
- Re-aligned Access Road
- Coffer Dams
- ANFO Facility
- Explosives Magazine
- Diversion Channels
- Raw Water Dam Existing Water Body
- Indicative Raw Water Dam
- Proposed Saddle Dam
- Water Treatment Plant
- Proposed Saddle Dam (Raw Water Dam)
- Retention Pond 1
- Stockpile

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number 43-21801
Revision 1
Date 07 Jun 2013

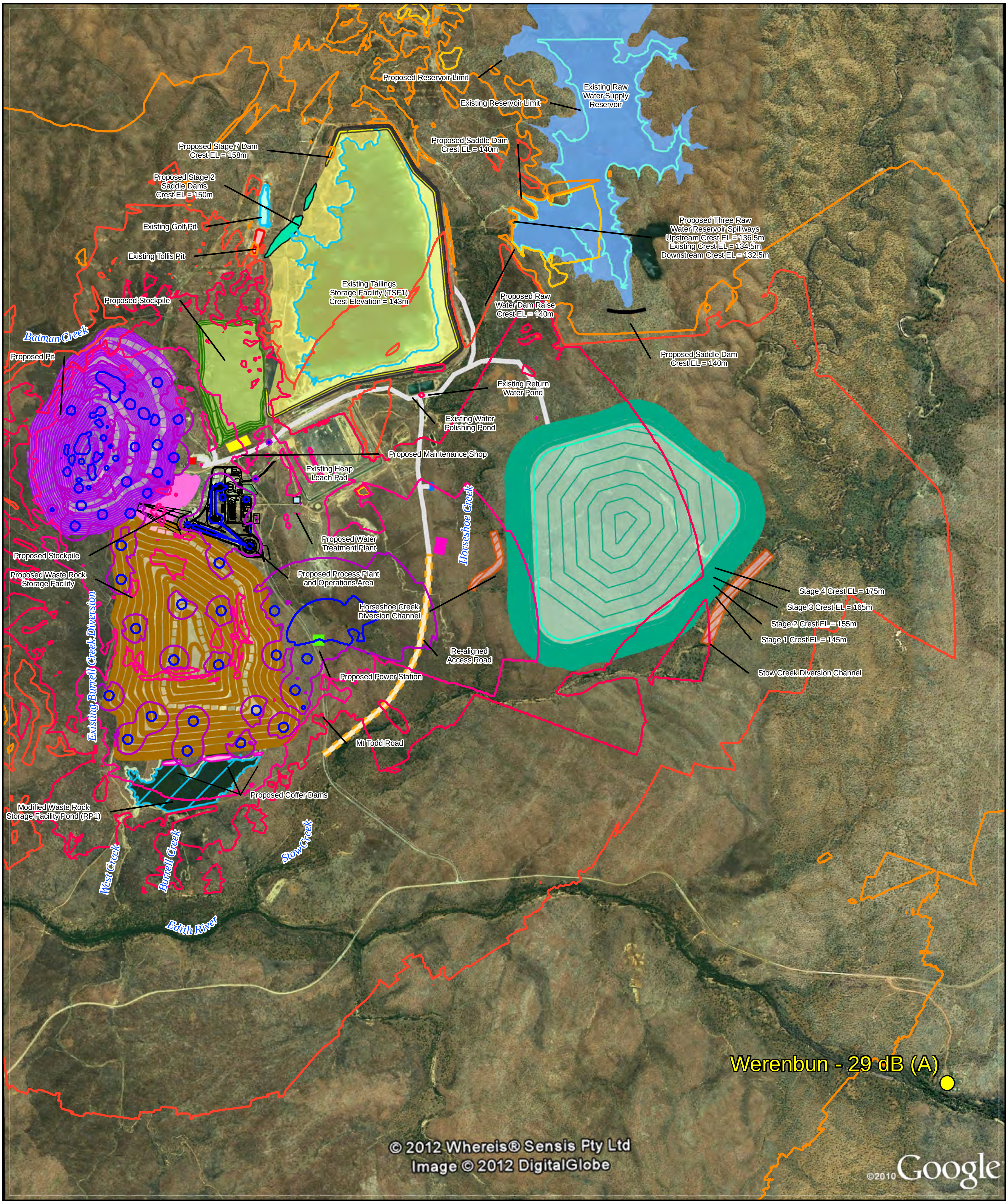
Proposed Mine Site Staging

Figure 13

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_404.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013). GHD - Creek Names (2011). Created by: CM



LEGEND

Werenbun Noise Level	40	Golf Pit	Re-aligned Access Road	Indicative Raw Water Dam	Low Grade Ore Stockpile Contours	Batman Pit Contours (Year 12)
Sound pressure level dB(A)	50	Tollis Pit	Coffer Dams	TSF1 Contours	Low Grade Ore Stockpile	Proposed Saddle Dam (Raw Water Dam)
20	60	Fuel Bays	ANFO Facility	TSF1 Existing Water Body	TSF2 Impounded Surface Area (Year 12)	Retention Pond 1
30	70	Proposed Maintenance Shop	Explosives Magazine	Proposed Saddle Dam	TSF2 Contours (Year 12)	Batman Pit Footprint (Year 12)
	80	Power Plant	Diversion Channels	TSF1_Wall_VG_20130517	TSF2 Footprint (Year 12)	Waste Rock Dump Contours (Year 10)
	Process Plant	Proposed Haul Road	Raw Water Dam Existing Water Body	TSF1	Water Treatment Plant	Waste Rock Dump Footprint (Year 10)

Stockpile

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number	43-21801
Revision	1
Date	07 Jun 2013

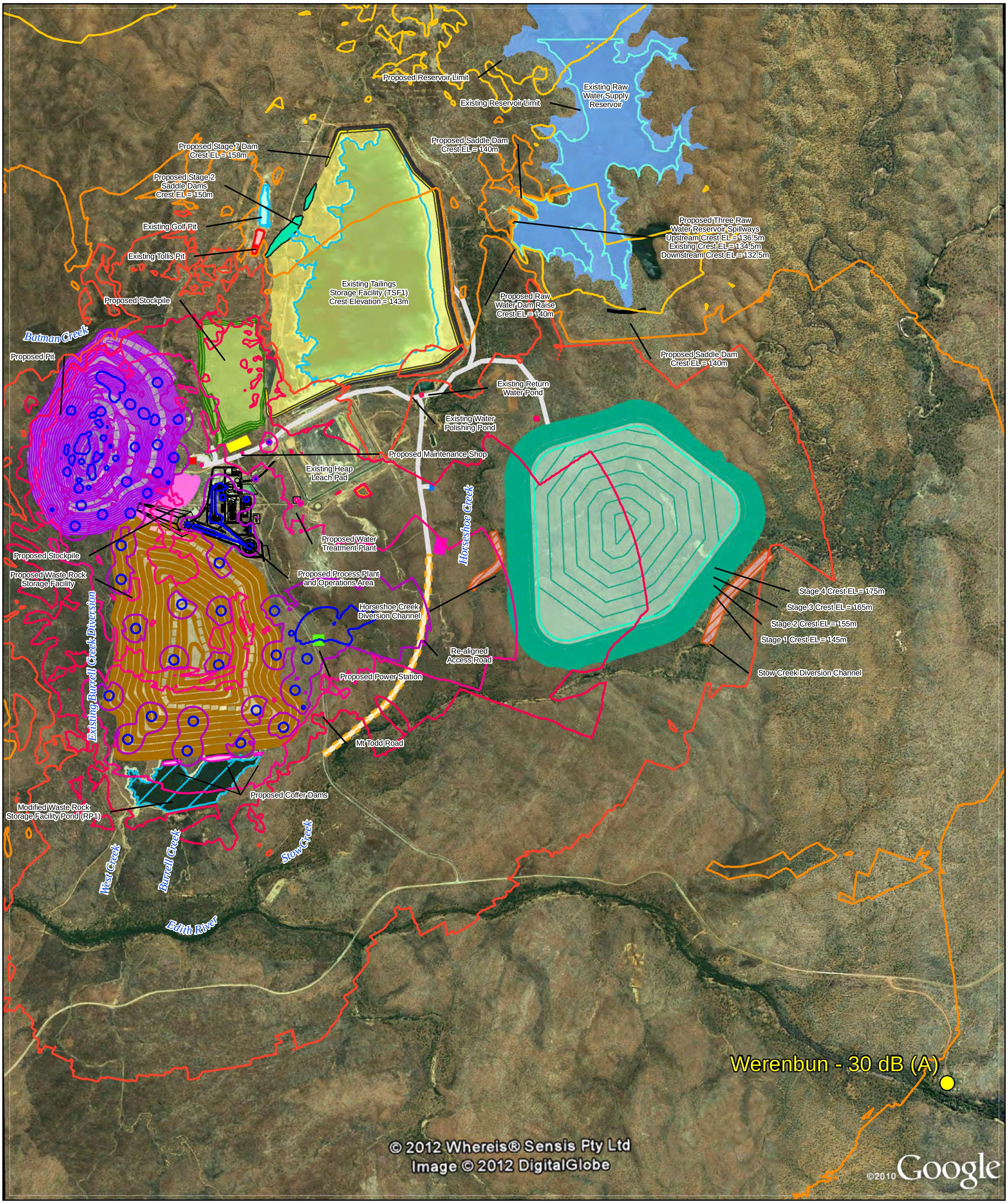
Predicted Mine Operation Noise Levels Temperature Inversion

Figure 14

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_405.mxd

66 Smith Street Darwin NT 0800 Australia **T** 61 8 8982 0100 **F** 61 8 8981 1075 **E** drwmail@ghd.com **W** www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013).
GHD - Creek Names, Noise Contours, Werenbun Noise Level (2011). Created by: CM



LEGEND

Werenbun Noise Level	40	Golf Pit	Re-aligned Access Road	Indicative Raw Water Dam	Low Grade Ore Stockpile Contours	Batman Pit Contours (Year 12)
Sound pressure level dB(A)	50	Tollis Pit	Coffer Dams	TSF1 Contours	Low Grade Ore Stockpile	Proposed Saddle Dam (Raw Water Dam)
20	60	Fuel Bays	ANFO Facility	TSF1 Existing Water Body	TSF2 Impounded Surface Area (Year 12)	Retention Pond 1
30	70	Proposed Maintenance Shop	Explosives Magazine	Proposed Saddle Dam	TSF2 Contours (Year 12)	Batman Pit Footprint (Year 12)
	80	Power Plant	Diversion Channels	TSF1_Wall_VG_20130517	TSF2 Footprint (Year 12)	Waste Rock Dump Contours (Year 10)
	Process Plant	Proposed Haul Road	Raw Water Dam Existing Water Body	TSF1	Water Treatment Plant	Waste Rock Dump Footprint (Year 10)
						Stockpile

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

GHD

MT TODD

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Predicted Mine Operation Noise Levels Wet Season

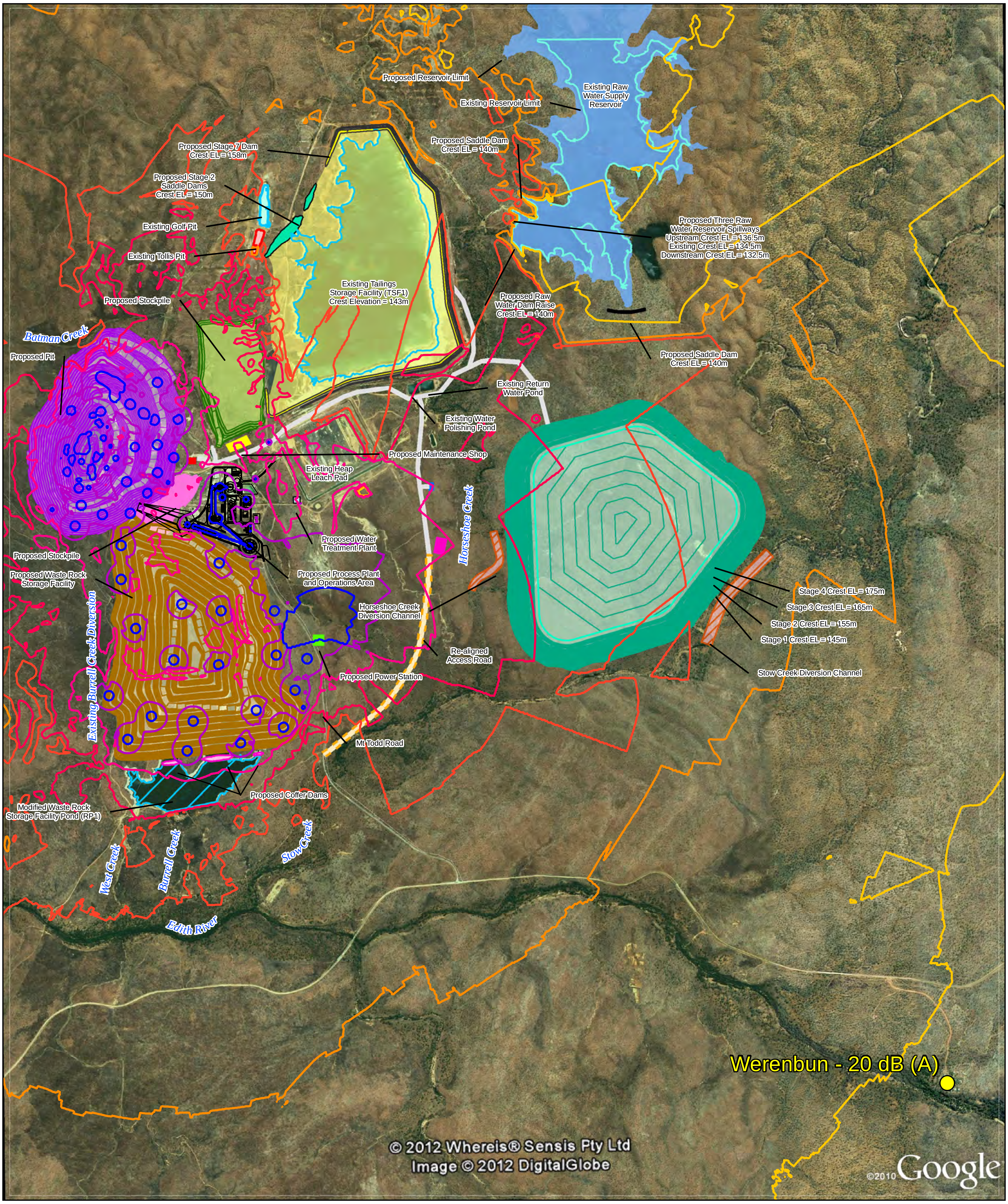
Job Number	43-21801
Revision	1
Date	07 Jun 2013

Figure 15

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_406.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013). GHD - Creek Names, Noise Contours, Werenbun Noise Level (2011). Created by: CM



LEGEND

- Werenbun Noise Level

Sound pressure level dB(A)

- 20
- 30
- 40
- 50
- 60
- 70
- 80
- Process Plant
- Golf Pit
- Tollis Pit
- Fuel Bays
- Proposed Maintenance Shop
- Power Plant
- Proposed Haul Road
- Re-aligned Access Road
- Coffer Dams
- ANFO Facility
- Explosives Magazine
- Diversion Channels
- Raw Water Dam Existing Water Body
- Indicative Raw Water Dam
- TSF1 Contours
- TSF1 Existing Water Body
- Proposed Saddle Dam
- TSF1_Wall_VG_20130517
- TSF1
- Low Grade Ore Stockpile Contours
- Low Grade Ore Stockpile
- TSF2 Impounded Surface Area (Year 12)
- TSF2 Contours (Year 12)
- TSF2 Footprint (Year 12)
- Water Treatment Plant
- Batman Pit Contours (Year 12)
- Proposed Saddle Dam (Raw Water Dam)
- Retention Pond 1
- Batman Pit Footprint (Year 12)
- Waste Rock Dump Contours (Year 10)
- Waste Rock Dump Footprint (Year 10)
- Stockpile

0 0.25 0.5 0.75 1

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Predicted Mine Operation Noise Levels Dry Season

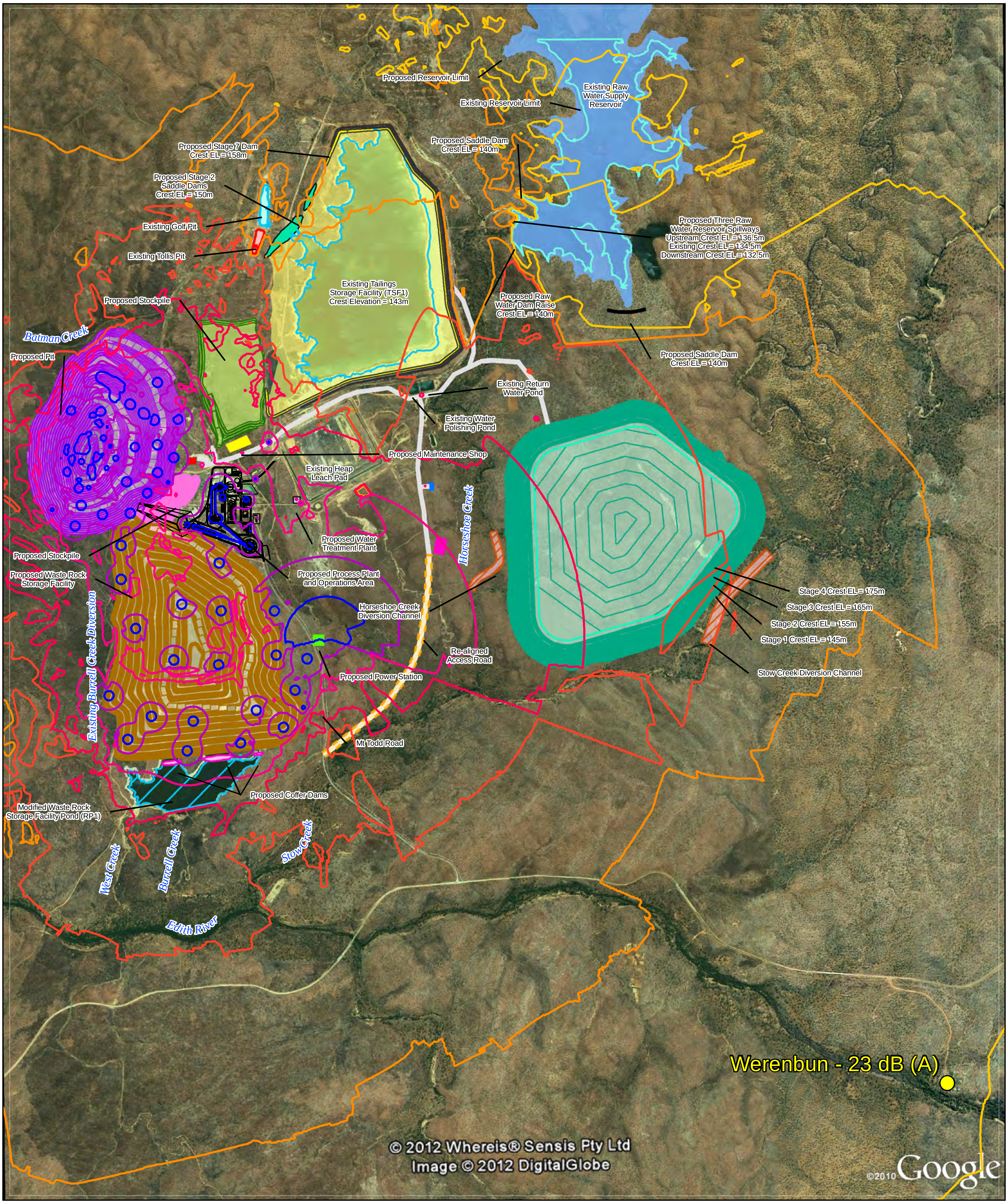
Job Number	43-21801
Revision	1
Date	07 Jun 2013

Figure 16

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_407.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013). GHD - Creek Names, Noise Contours, Werenbun Noise Level (2011). Created by: CM



LEGEND

Werenbun Noise Level	40	Golf Pit	Re-aligned Access Road	Indicative Raw Water Dam	Low Grade Ore Stockpile Contours	Batman Pit Contours (Year 12)
Sound pressure level dB(A)	50	Tollis Pit	Coffer Dams	TSF1 Contours	Low Grade Ore Stockpile	Proposed Saddle Dam (Raw Water Dam)
20	60	Fuel Bays	ANFO Facility	TSF1 Existing Water Body	TSF2 Impounded Surface Area (Year 12)	Retention Pond 1
30	70	Proposed Maintenance Shop	Explosives Magazine	Proposed Saddle Dam	TSF2 Contours (Year 12)	Batman Pit Footprint (Year 12)
	80	Power Plant	Diversion Channels	TSF1_Wall_VG_20130517	TSF2 Footprint (Year 12)	Waste Rock Dump Contours (Year 10)
	Process Plant	Proposed Haul Road	Raw Water Dam Existing Water Body	TSF1	Water Treatment Plant	Waste Rock Dump Footprint (Year 10)

Stockpile

0 0.25 0.5 0.75 1
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia
Grid: Map Grid of Australia 1994, Zone 53

N

Vista Gold Australia Pty Ltd
Mt Todd Gold Project

Job Number 43-21801
Revision 1
Date 07 Jun 2013

Predicted Mine Operation Noise Levels Neutral Conditions

Figure 17

G:\43\21801\GIS\Maps 30000 TPA\NoiseVibrationAssessment\4321801_408.mxd

66 Smith Street Darwin NT 0800 Australia T 61 8 8982 0100 F 61 8 8981 1075 E drwmail@ghd.com W www.ghd.com.au

Data source: Tetra Tech - Process Plant, Golf Pit, Tollis Pit, Fuel Bays, Proposed Maintenance Shop, Power Plant, Realigned Roads, Proposed Haul Road, Coffer Dams, ANFO Facility, Explosives, Diversion Channels, Raw Water Dam Existing Water Body, Indicative Raw Water Dam, TSF1 Contours, TSF1 Existing Water Body, Proposed Saddle Dam, TSF1, Low Grade Ore Stockpile Contours, Low Grade Ore Stockpile, TSF2 Impounded Surface Area, TSF2 Contours, TSF2 Footprint, Water Treatment Plant, Batman Pit Contours, Proposed Saddle Dam (Raw Water Dam), Retention Pond 1, Batman Pit Footprint, Waste Rock Dump Contours, Waste Rock Dump Footprint, Stockpile (2013). Google Earth Pro - Imagery (Date extracted: 17/05/2013).
GHD - Creek Names, Noise Contours, Werenbun Noise Level (2011). Created by: CM

5.3.4 Traffic Noise Impacts

Road access for the traffic including construction, service, delivery and workforce vehicles will be exclusively through the existing road infrastructure (Edith Falls Road/Jatbula Road).

The closest noise sensitive receptor to the Edith Falls Road / Jatbula Road intersection is Werenbun, approximately 4km away. As such, the estimated increase in traffic noise due to the Project will not be noticeable to Werenbun receptors. A potential internal realignment of Jatbula Road is not expected to increase off-site noise levels.

5.3.5 Operation Blasting Impact

Blasting impacts were indicatively estimated with consideration to Australian Standard 2187.2-2006 Explosives – Storage and use Part 2: Use of Explosives (AS2187.2-2006) and are based on available information. Blasting vibrations are non-linear in nature and variability in ground type and meteorological conditions makes it difficult to accurately predict ground vibration and airblast overpressure without site specific measurement data. The blasting predictions provided below should only be used as a guide.

As required in the ANZECC guideline, blasting should only occur between the hours of 9am to 5pm (Monday to Friday), as well as on Sundays or Public Holidays.

Estimation of Airblast Overpressure from Blasting

Airblast overpressure can be estimated using the following equation:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^a$$

Where:

P is the pressure (kPa)

R is the distance from charge (m)

Q is the charge mass (kg)

Ka is the site constant. AS2187.2-2006 suggests that, for confined blasthole charges values, are commonly in the range of 10 to 100. A value of 50 has been adopted for this assessment.

a site exponent. For confined blasthole charges AS 2187.2-2006 suggests a = -1.45 as a satisfactory estimate.

Airblast overpressure propagation can be increased with unfavourable meteorological conditions and decreased with topographic shielding. Unconfined surface charges would considerably increase the airblast overpressure propagation.

Estimation of Ground Vibration from Blasting

Ground vibration was estimated using the following equation:

$$V = K_G \left(\frac{R}{Q^{1/2}} \right)^{-1.6}$$

Where:

V is the peak vector sum ground vibration ppv (mm/s)

R is the distance from charge (m)

Q is the maximum instantaneous charge (MIC) (kg)

K_G is the ground constant. AS 2187.2-2006 gives a site constant for a free face in average field conditions of 1140, which has been used for the predictions. This value can vary from 1/5 times to 4 times depending on ground conditions and other factors.

Blasting Predictions

Reducing the charge mass or increasing the distance reduces the airblast overpressure and ground vibration. Airblast overpressure and ground vibration were predicted for a range of charge masses.

Charge mass estimates to achieve the maximum operation airblast overpressure criteria of 115dB(L) and ground vibration criteria of 5mm/s PPV are shown in Table 24.

Table 24 Charge Mass Estimates

Distance to Receptor (m)	MIC (kg) to Meet 115dB(L)	MIC (kg) to Meet 5mm/s PPV
7,000	>100	>100
6,000	>100	>100
5,000	>100	>100
4,000	>100	>100
3,000	>100	>100
2,000	>100	>100
1,000	28	>100
500	3.5	>100

No details of the blast configuration and design have been supplied at this stage. Generally, a maximum instantaneous charge (MIC) of greater than 100kg should not be required and a charge of 50kg or less is likely to be appropriate. As the nearest receptor is greater than 7 km away, ground vibration from blasting is not predicted to be an issue.

Adverse meteorological conditions such as temperature inversions and wind direction can significantly increase airblast overpressure levels. Temperature inversions are most common during night and early morning periods. This should not affect blasting so long as it occurs during the hours recommended in the ANZECC guideline.

The above information is provided for guidance only. Any blast on site should be designed by a qualified contractor and include consideration of the blasting noise and vibration limits outlined in this report.

5.3.6 Noise Impacts on Native Fauna and Livestock

Overview

Research indicates that there are no government policies or widely accepted guidelines with regard to noise criteria for animals at this point in time. Information is provided in technical literature and has been reviewed for the Project.

Livestock

The noise goals provided in this report are based on human response and annoyance factors and, as such, are not applicable to livestock or other non-human receivers. Sudden noise has the potential to startle or upset domestic livestock and pets.

Heggies Pty Ltd conducted a literature review as part of their assessment of blasting noise impacts on livestock for the proposed Caval Ridge Coal Mine Project (Heggies, 2009). Heggies cites results from a study on the response of farm animals to sonic booms (sonic booms being similar in character to airblast from blasting), which indicated that reactions of sheep, horses and cattle to sonic booms (125dB to 136dB) were considered slight to mild.

The numbers of animals observed under sonic boom conditions include 10,000 commercial feedlot beef cattle, 100 horses, 150 sheep and 320 lactating dairy cattle.

Booms test schedule was designed at varying intervals during morning hours Monday to Friday of each week.

Results showed that there was only 19 of 104 booms caused even a mild reaction on sheep, horses and dairy cattle in temporary cessation of eating, rising of heads and slight startle effects. The total individual milk yield has been observed during the test period and no affect has been found on the overall milk production.

Given these conclusions, it is considered unlikely that the Project would have an adverse effect on livestock in the vicinity of the Project.

Native Fauna

The effect of noise on wildlife can be similar to the effects observed in humans. Noise can adversely affect wildlife by interfering with communication, masking the sounds of predators and prey, cause stress or avoidance reactions and (in the extreme) result in temporary or permanent hearing damage. Experiments have shown that exposure to noise impulses throughout the night-time sleep period resulted in poorer daytime task performance by animals (see Fletcher & Busnel, 1978).

The learning ability of many animal species, in regard to familiarisation, is discussed by Fletcher & Busnel, 1978. The animal's initial reaction to a new noise source is fright and avoidance but if other sensory systems are not stimulated (for instance optical or smell), the animal learns quite quickly to ignore the noise source, particularly when it exists in the presence of man.

Migratory birds have the potential to be influenced by noise from the Project. Studies of birds (Larkin *et al*, 1996) have shown that they will habituate to loud noises that are not biologically meaningful for them. For example if the noise is associated with possible harm such as thunder on a cloudy day, birds will avoid it, but routine noises such as traffic will not disturb them. Moreover, Heggies states that sudden impulsive noise could cause birds or other wild animals to become startled, which would affect the feeding and breeding habits on some species should long term exposure occurs. However, it was observed that they have high tolerance on intermittent or moderate noise events, such as traffic noise, (Heggies , 2009). Examples are provided of sea-birds that voluntarily co-exist with relatively loud noise environments, such as around airports, and birds roosting on light-posts above busy motorways.

Attempts at using noise to deliberately scare birds away from an area, for example to protect farming crops, have been shown to grow less effective over time as birds habituate to the noise. Larkin suggests that keeping the noise as consistent as possible both in the sound produced and the frequency with which it occurs may also help mitigate its effects on birds. Poole (1982) and Algers *et. al.* (1978) shows that birds tend to adapt to steady state noise levels, even of a relatively high level (in the order of 70 dB(A)). Given the predicted steady noise levels around the Project are expected to be much less than this level, noise impacts on birds surrounding the Project is considered acceptable.

Summary

Available literature suggests that the impact of noise from the Project is unlikely to result in negative impacts to either livestock or native fauna. As such, it is not proposed to provide any specific management measures, other than those proposed in regard to management of impacts to human receptors.

6. Mitigation and Control Measures

Although not expected to cause adverse noise impacts, GHD recommends that the following measures be taken into consideration during construction and operation of the Project in order to minimise the risks of noise impact.

6.1 Construction Noise

NT EPA has recommended the development of a Noise Management Plan (NMP), which is to include, as a minimum:

- Justification for work on the development site, that is likely to be undertaken outside of the acceptable construction times (between the hours of 7 am and 7 pm Monday to Saturday and/or between the hours of 9 am to 6 pm on a Sunday or Public Holidays);
- Details and the duration of the activities on the development site likely to cause noise emissions that may exceed the construction noise levels defined in Noise guidelines for development sites in the Northern Territory (NT EPA 2013) during a period specified in Clause 10.1;
- Details clearly demonstrating how site activity will comply with 'AS 2436 Guide to Noise and Vibration Control on Construction, Maintenance and Demolition Sites';
- Documented complaint response procedures and how the procedures will be implemented;
- Documentation on the verifiable consultation and feedback program with occupants of all affected premises, demonstrating that all occupants were provided with advice on dates, times and nature of any potentially noisy and disruptive activity including measures proposed to mitigate such activity as well as noise complaint contact details; and
- Name of the onsite person who will be responsible for implementing the NMP and the name and phone number of the person to whom a complaint may be made about noise emissions from the site.

In addition, the following general construction noise mitigation measures could be implemented:

- All work should be kept within the standard working hours prescribed by the NT EPA;
- Review available fixed and mobile equipment fleet and prefer more recent and silenced equipment whenever possible. In any case, all equipment used on site should be in good condition and good working order;
- Plan to use equipment which is fit for the required tasks in terms of power requirements;
- All engine covers should be kept closed while equipment is operating;
- As far as possible, material drop heights into or out of trucks should be minimised;
- Broadband reversing alarms (audible movement alarms) should be used for all site equipment, subject to meeting occupational health and safety requirements;
- All combustion engine plant, such as generators, compressors and welders should be checked to ensure they produce minimal noise with particular attention to residential grade exhaust silencers;
- Vehicles should be kept properly serviced and fitted with appropriate mufflers. The use of exhaust brakes should be eliminated, where practicable;

- Where practical, machines should be operated at low speed or power and should be switched off when not being used rather than left idling for prolonged periods;
- Machines found to produce excessive noise compared to industry normal standard should be removed from the site or stood down until repairs or modifications can be made; and
- Where practical, impact wrenches should be used sparingly with hand tools or quiet hydraulic torque units preferred.

6.2 Operational Noise

6.2.1 General Noise Mitigation Measures

- All mobile equipment should be selected to minimise noise emissions and maintained in good repair. Equipment should be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations should be removed from the site or stood down until repairs or modifications can be made;
- Haul roads should be kept smooth and free of potholes and bumps; and
- Broadband reversing alarms (audible movement alarms) should be used for all site equipment, subject to meeting occupational health and safety requirements.

6.2.2 General Work Practices

All site workers should be aware of the potential for noise impacts and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities. These measures should include:

- Avoiding the use of loud radios;
- Avoiding shouting and slamming doors;
- Where practical, machines should be operated at low speed or power and switched off when not being used rather than left idling for prolonged periods;
- Informing truck drivers of designated vehicle routes, parking locations and delivery hours;
- Minimising reversing;
- Avoiding dropping materials from height;
- Avoid metal to metal contact on material; and
- All engine covers should be kept closed while equipment is operating.

6.2.3 Complaint Management

Although it is not expected the operations of the mine will cause adverse noise or vibration impacts, a complaint system will be implemented during construction of the Project. The complaint system will include the following measures as relevant:

- A community liaison phone number and permanent site contact number should be established and made available to nearby residents and other noise sensitive receptors so that noise related complaints can be received and addressed in a timely manner;

- Investigation as to whether any unusual activities were taking place at the time of the complaint that may have generated higher noise levels than usual;
- Conduct noise and/or vibration (as applicable) monitoring at the location of the complainant if the complaint is deemed justified. Monitoring would be undertaken and reported within five days of receiving a complaint, if that activity is continuing, so that the monitoring findings can be incorporated to the written response provided to the complainant; and
- If exceedances are detected, corrective actions would be implemented, included in the response to the complainant and recorded.

Upon receipt of a noise and/or vibration complaint, complaints would be addressed in accordance with the above complaint management system. Based on experience with similar projects, response to the complaint would include but not limited to:

- Provision of a written response to a complaint within seven days; and
- Provision of an email response to an electronic complaint within two days if the complaint cannot be resolved by an initial response.

6.2.4 Blasting Mitigation Measures

Any blast on site should be designed by a qualified contractor and include consideration of the blasting noise and vibration limits outlined in this report.

7. Conclusion

7.1.1 Existing Noise levels

Measured background noise levels at the mine site are low and typical of a rural environment.

7.1.2 Construction Noise and Vibration

The results of the construction assessment indicate that noise and vibration levels of the mine are expected to comply with nominated noise criteria at all times for noise and vibration sensitive receptors.

Construction noise is not expected to cause adverse impacts at noise receptors. However, in order to reduce the risk of noise impact, the mitigation measures outlined in Section 6 of this report should be taken into consideration during construction.

7.1.3 Operational Noise and Vibration

The results of the operational assessment indicate that the operational noise and vibration impact of the Mt Todd Gold Project is expected to comply with the nominated noise criteria at all times for noise and vibration sensitive receptors assessed under all weather conditions.

Noise model results indicate the predicted low frequency difference for C-weighted and A-weighted noise levels over the same period is less than 15dB. Therefore, the correction for low frequency noise as specified in INP was not added to the predicted noise levels at the receiver.

A mine site noise model predicts potential noise levels for a worst-case mine operating scenario which assumed mining activities operating in the southern most area of the waste rock dump during the latest staging of the project. The model predicted noise levels under varying meteorological conditions, and has assumed that all machinery and plant on the mine site are operating continuously. Operational noise modelling results are valid for the modelled scenario, which assumes the air intakes of the MAN engines are effectively shielded by the engine hall in the direction of the Werenbun community. Once available the final layout of the facility should be reviewed to make sure the findings outlined in this report remain valid. If not, this may trigger noise attenuation requirements on the MAN engines air intakes.

Predicted noise levels under 'worst case' conditions (wind assisted conditions during the wet season) at the nearest noise sensitive receptor (Werenbun) is 30dB(A), which is below the noise criteria of 35dB(A).

The estimated increase in traffic noise levels due to the Project is not expected to be noticeable at Werenbun.

The nature and levels of vibration emitted by the mine will vary with the activities being undertaken on-site, however, due to the distances between the sources and receptors, vibration is unlikely to have a significant impact.

Airblast overpressure and ground vibration from blasting activities at the mine are predicted to comply with the project specific criteria.

Available literature suggests that the impact of noise from the Project is unlikely to result in negative impacts to either livestock or native fauna. As such, no specific management measures, other than those proposed in regard to management of impacts to human receptors, are suggested.

8. References

Algers, B., Ekesbo, I. and Stromberg, S. 1978. *The impact of continuous impact of noise on animal health.* Acta Veterinaria Scandinavica (Supplementum) 67:1-26.

ANZECC. 1990. *Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration*, September 1990. Australian and New Zealand Environment Council.

Australian Standard AS 2436 – 1981. *Guide to Noise Control on Construction, Maintenance and Demolition Sites.*

Australian Standard AS1055.1. *Acoustics – Description and measurement of environmental noise – Part 1: General Procedures*.

Australian Standard 2187.2 - 2006. Explosives – Storage and use Part 2: Use of Explosives, 2006

ASK. 2009. Cloncurry Copper Project.

BHP Billiton, 2009. Olympic Dam Expansion Draft EIS.

Bridges Acoustics, 2010. Grosvenor Coal Project EIS.

British Standard 6472 – 2008. *Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting, 2008*.

British Standard 5228-2:2009. *Code of practice for noise and vibration on construction and open sites – Part 2: Vibration*, 2009.

CONWAVE. 1981. Conservation of Clean Air and Water in Europe titled CONCAWE Report No. 4/81 - *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities.*

DECC. 2009. *Interim Construction Noise Guidelines*. Department of Environment and Climate Change, NSW.

DECCW. 2011. *NSW Road Noise Policy*. Department of Environment, Climate Change and Water, NSW.

DEEDI. 2011. *Management of oxides of nitrogen in open cut blasting Queensland* Guidance Note QGN 20 v 3, 2011. Department of Employment, Economic Development and Innovation.

DPI. 2006. *Road Traffic Noise on NT Government Controlled Roads*. Department of Planning and Infrastructure.

EPA. 2000. *Industrial Noise Policy*. NSW Environment Protection Authority.

Fletcher, J.L. and Busnel, R.G. (eds.). 1978. *Effects of Noise on Wildlife*. Academic Press, New York.

German Standard DIN 4150-3. *Structural Vibration – Part 3: Effects of vibration on structures*, 1999.

Heggies. 2009. Caval Ridge Coal Mine Project.

Larkin, R.P., Pater, L.L. and Tazik, D.J. 1996. *Effects of military noise on wildlife: A literature review*. USACERL Technical Report 96/21, January 1996.

NT EPA. 2013. *Noise guidelines for development sites in the Northern Territory*. Northern Territory Environment Protection Authority.

PB. 2008. Wandoan Coal Project EIS.

Poole, G. 1982. *Sound Advice Poultry Notes*. NSW Department of Agriculture and Fisheries.

Rio Tinto. 2004. Clermont Coal Project EIS.

RTA. 2001. *Environmental Noise Management Manual*. Roads and Traffic Authority - Version 1.0, 2011

Wiss, J.F. 1981. *Construction vibrations: State-of-the-Art*. American Society of Civil Engineers, ASCE Journal of Geotechnical Engineering, Vol. 107, No. GT2, pp. 167-181.

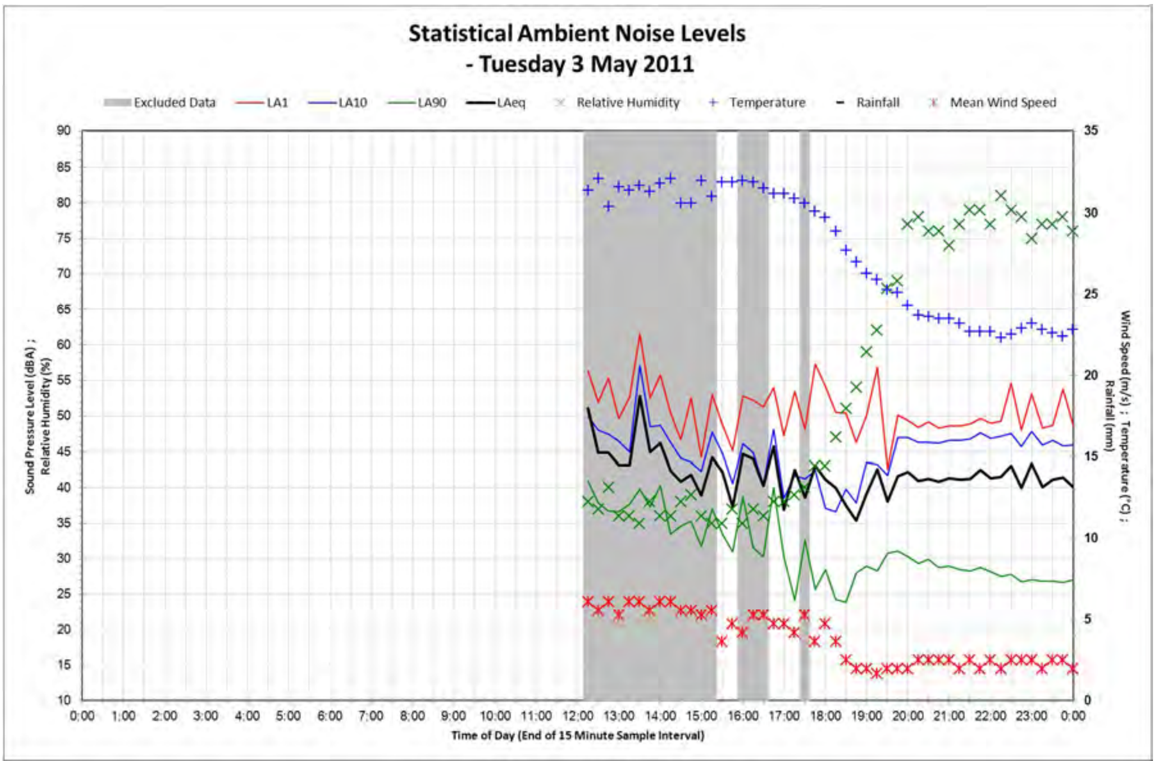
Appendix A

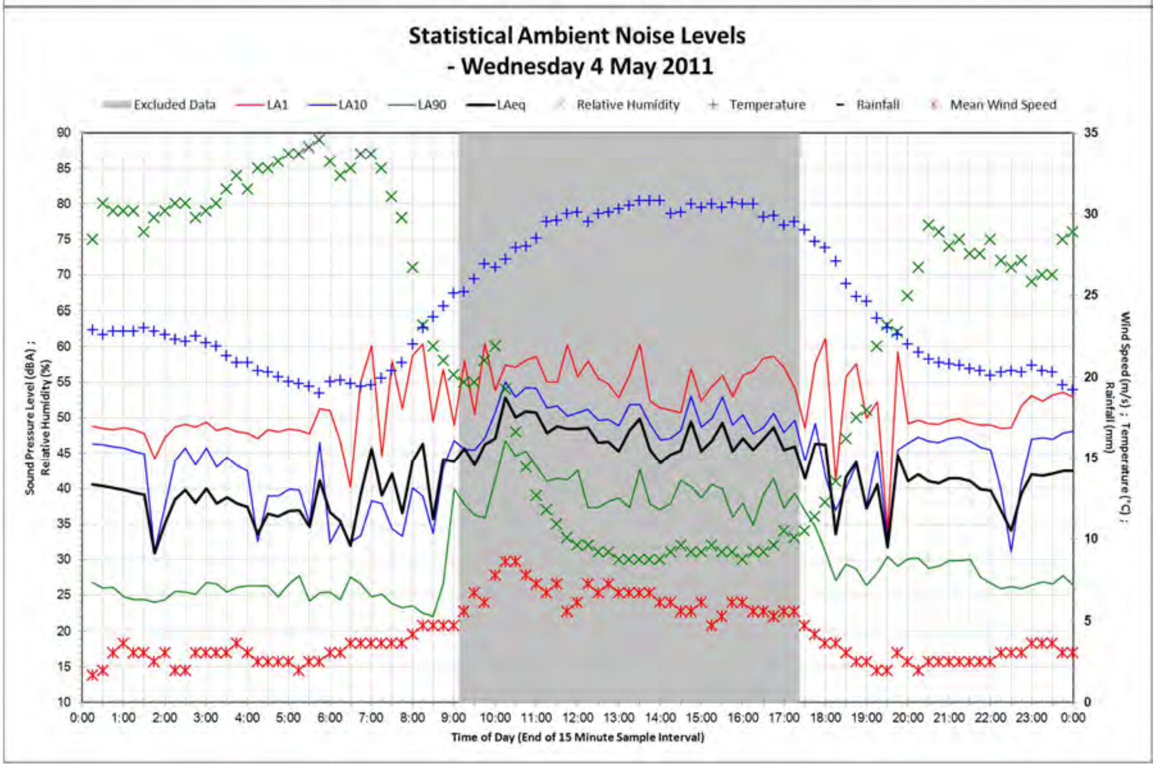
Noise Charts

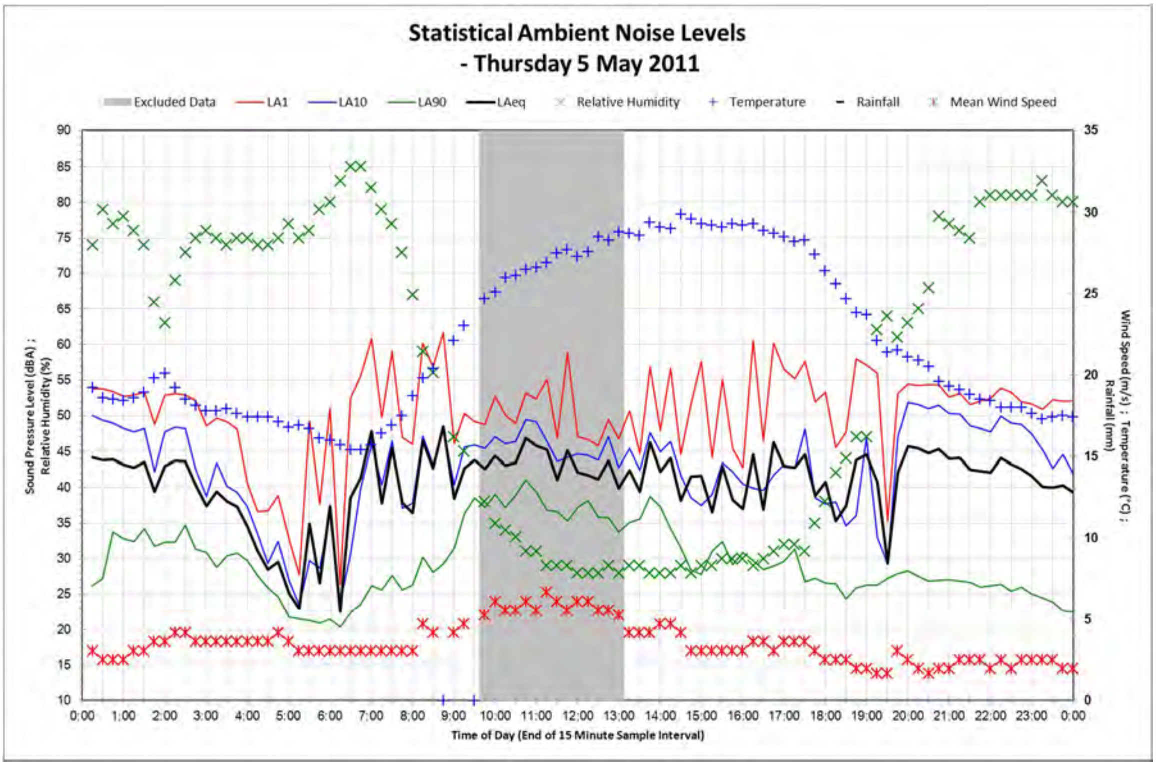
Logger 1

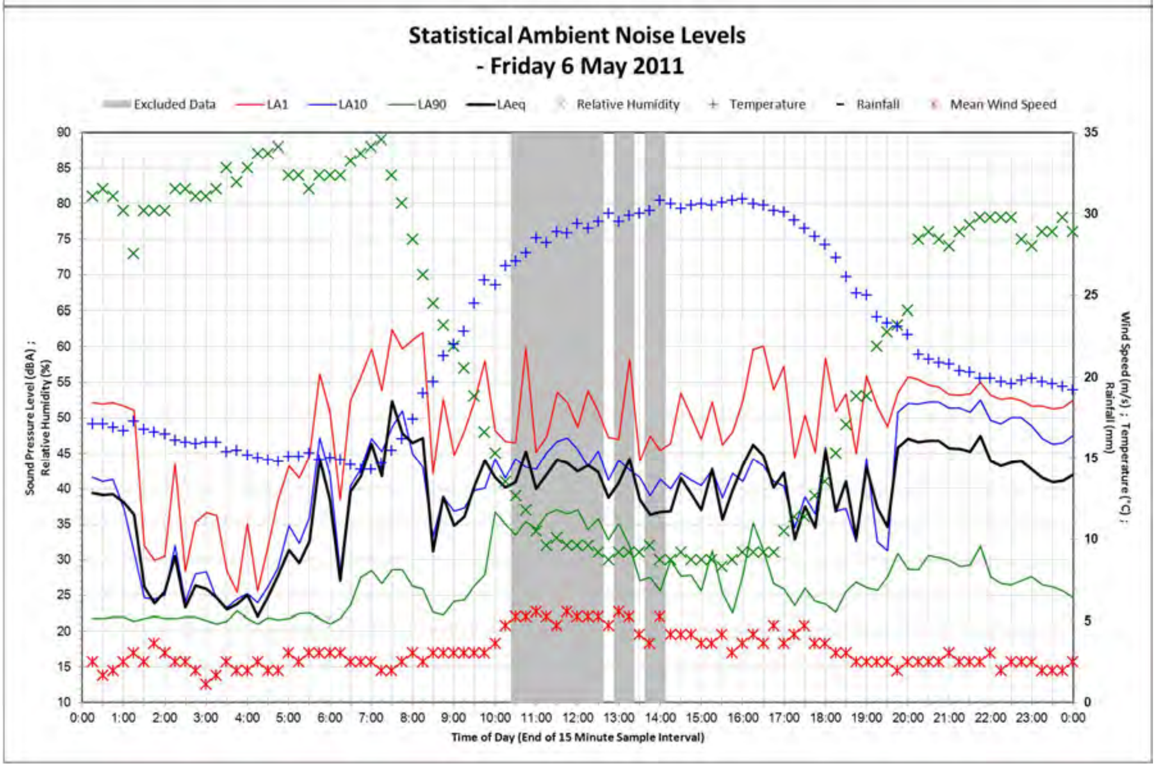
Logger 2

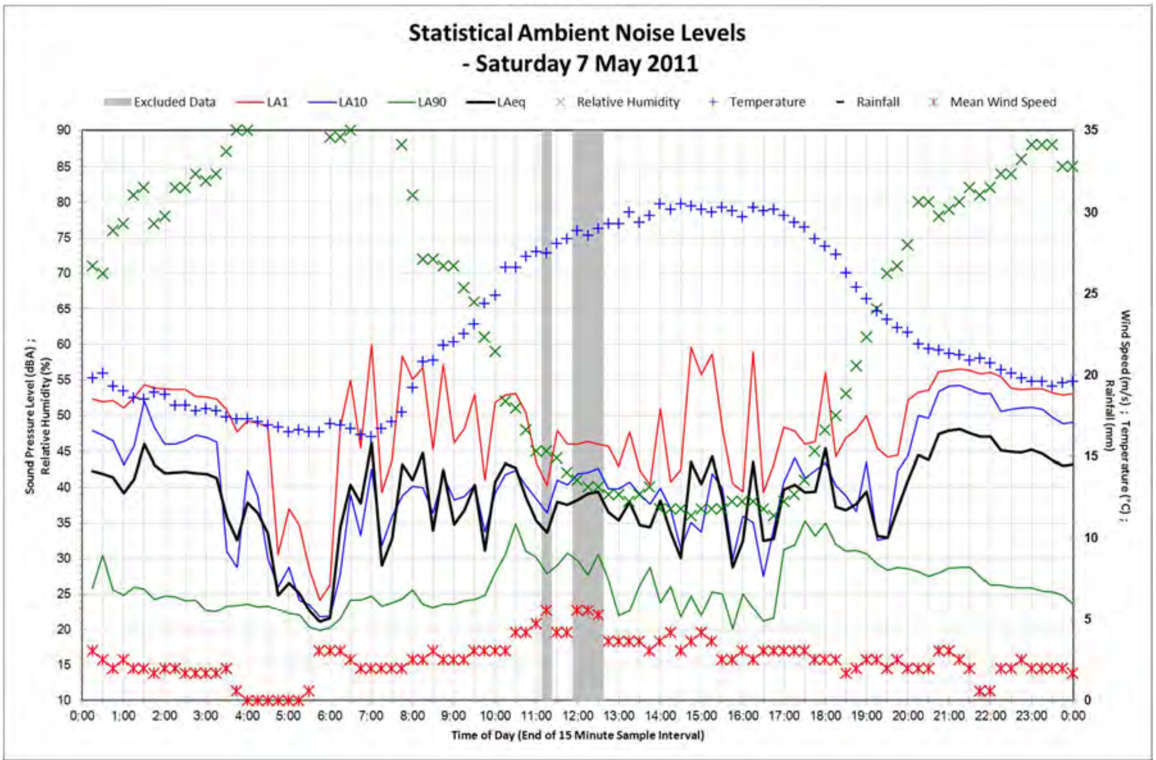
Logger 1

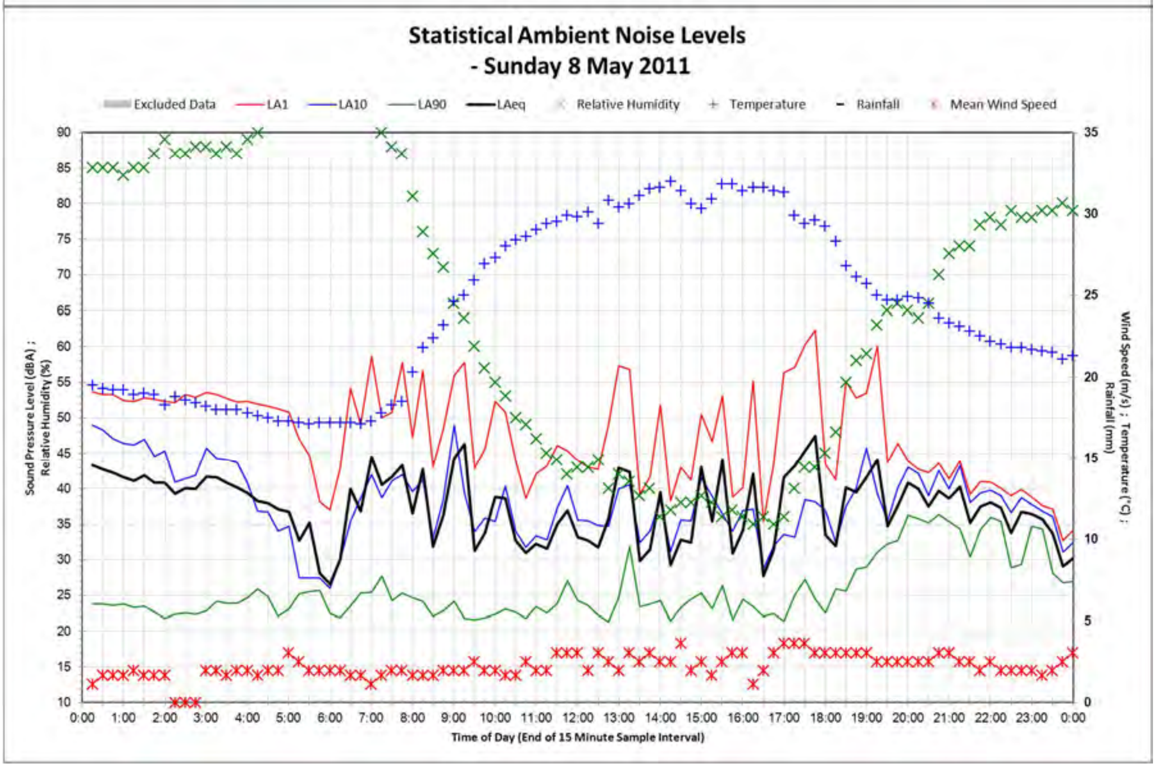

Statistical Ambient Noise Levels
- Tuesday 3 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
35
30
25
20
15
10
5
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00

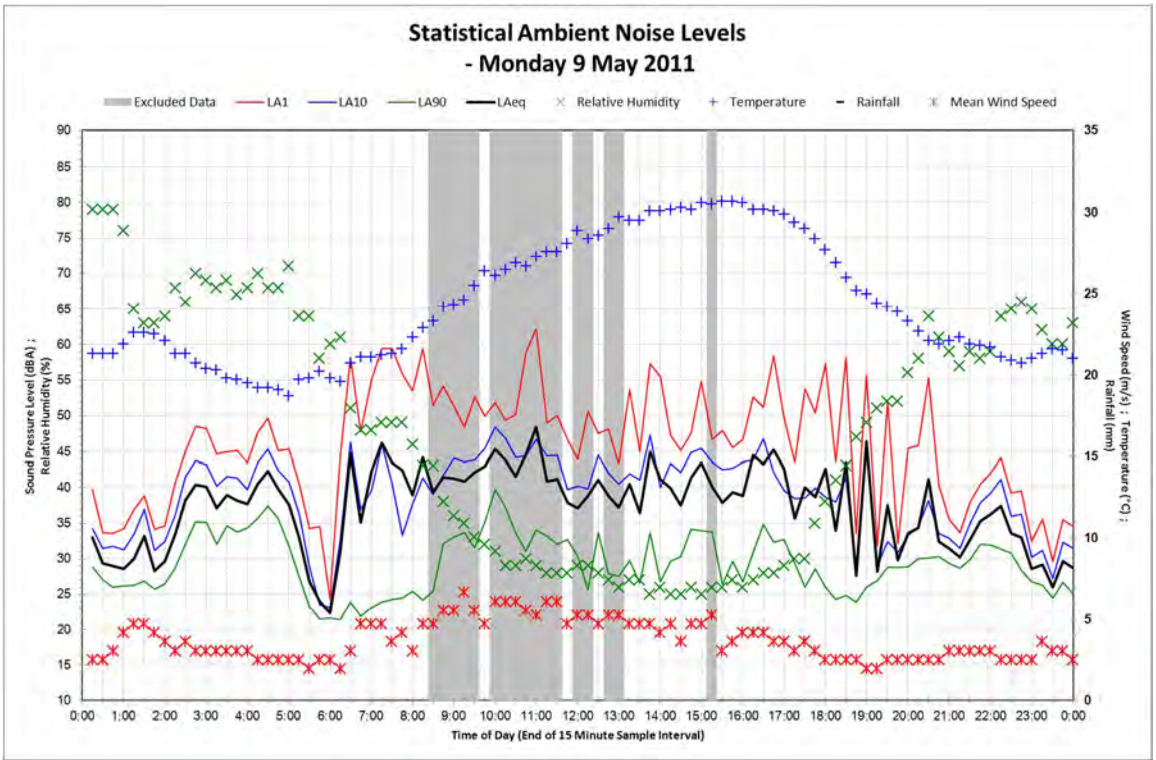

Statistical Ambient Noise Levels
- Wednesday 4 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
35
30
25
20
15
10
5
0
0:00 1:00 2:00 3:00 4:00 5:00 6:00 7:00 8:00 9:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 0:00

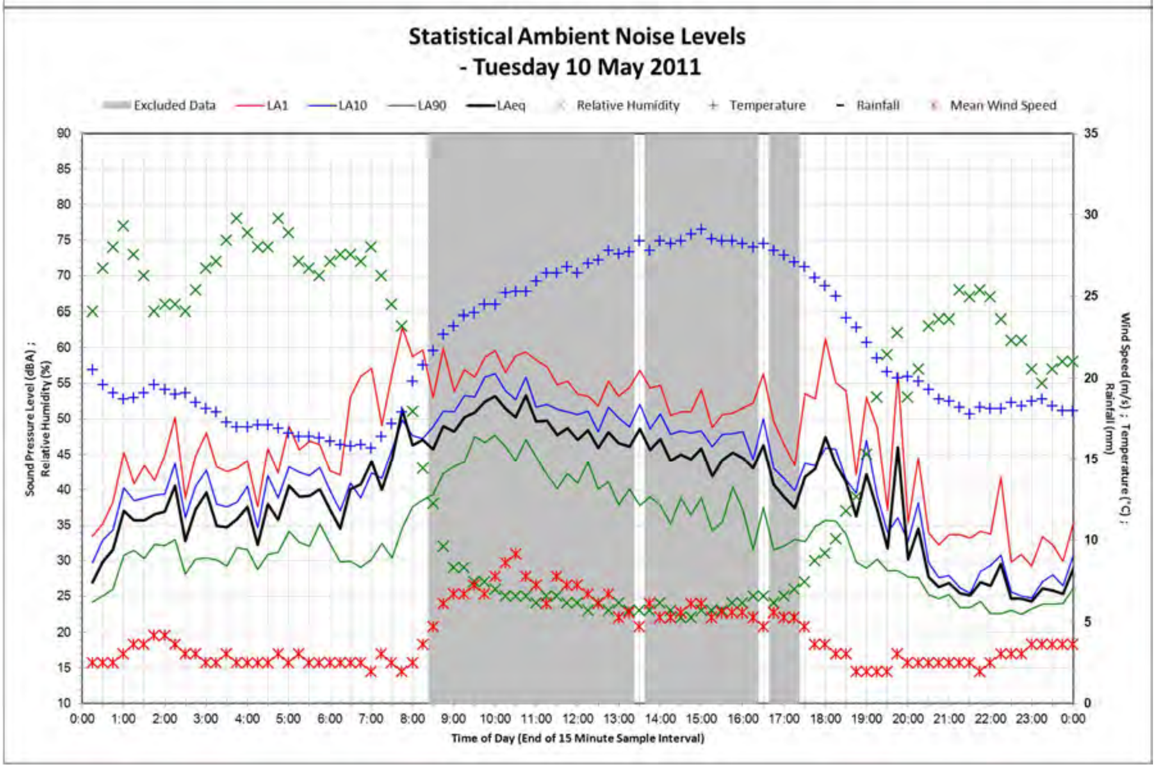

Statistical Ambient Noise Levels
- Thursday 5 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

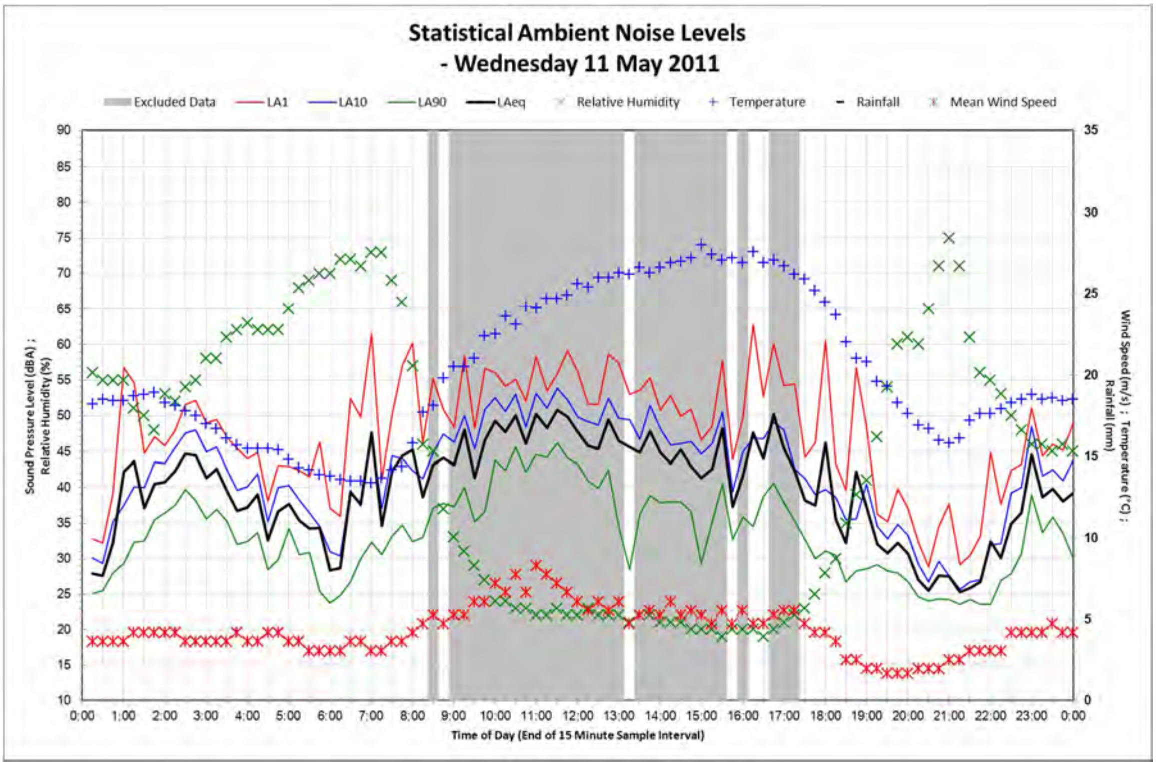

Statistical Ambient Noise Levels
- Friday 6 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

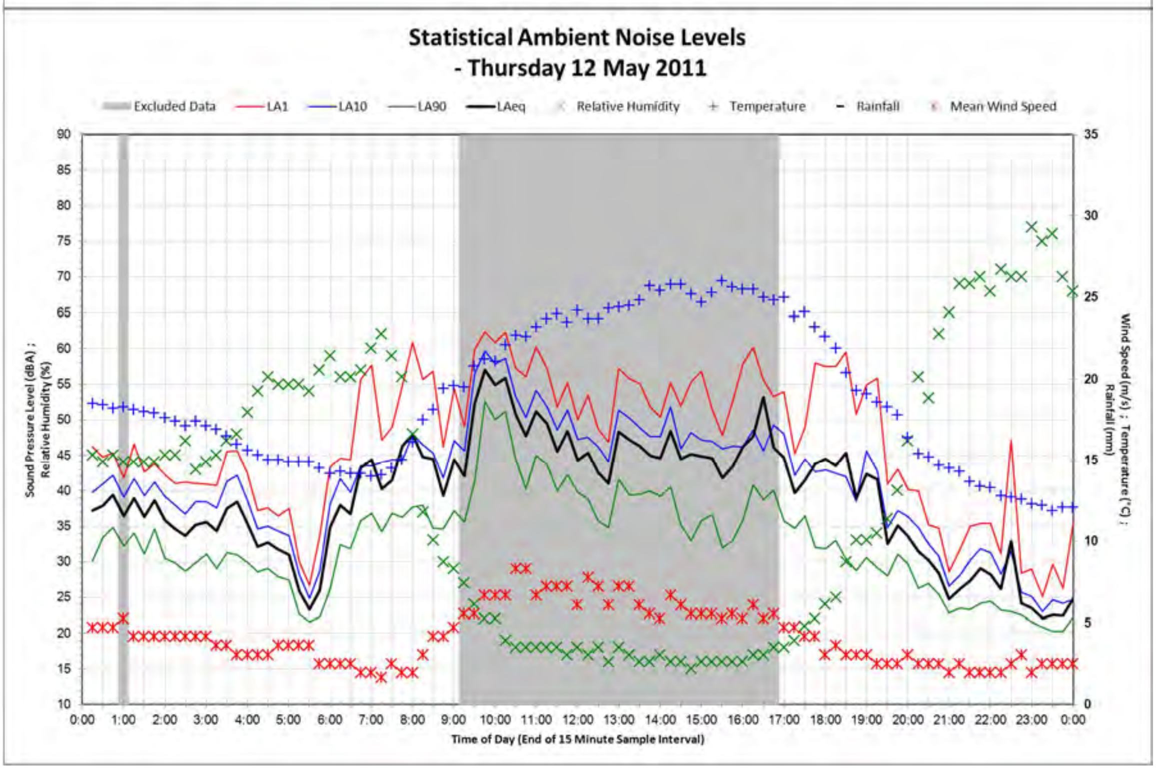

Statistical Ambient Noise Levels
- Saturday 7 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Sunday 8 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

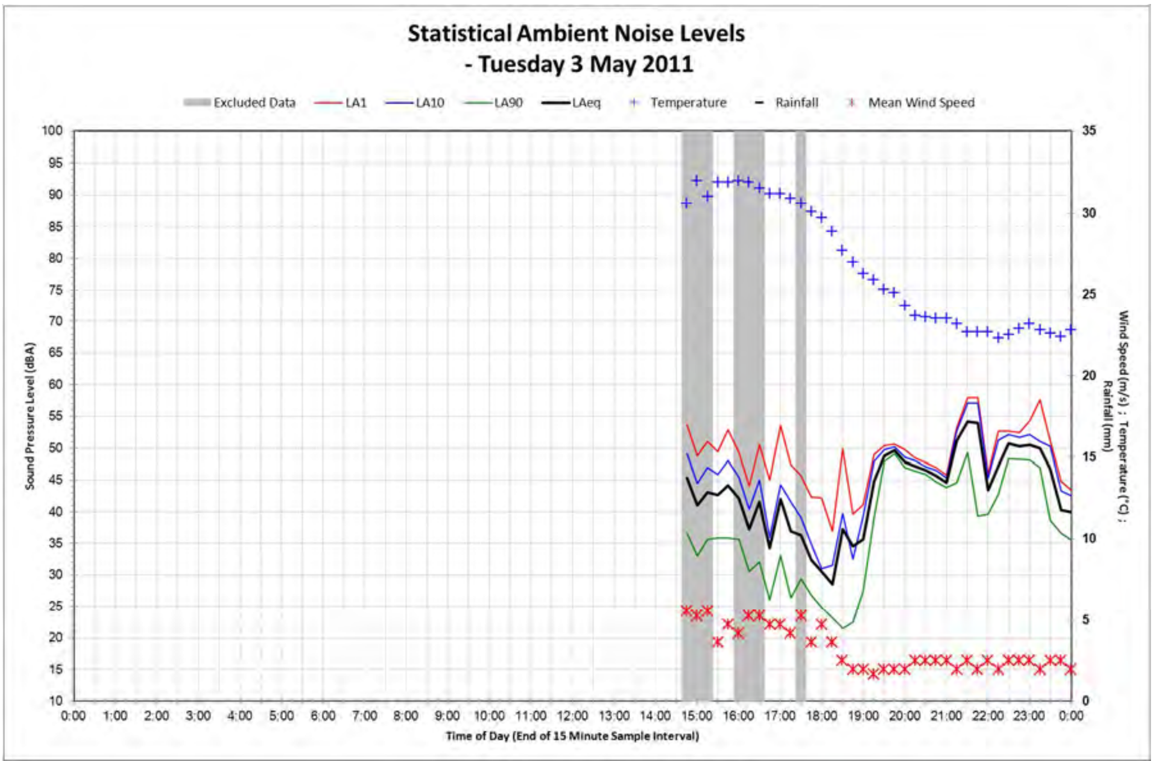

Statistical Ambient Noise Levels
- Monday 9 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

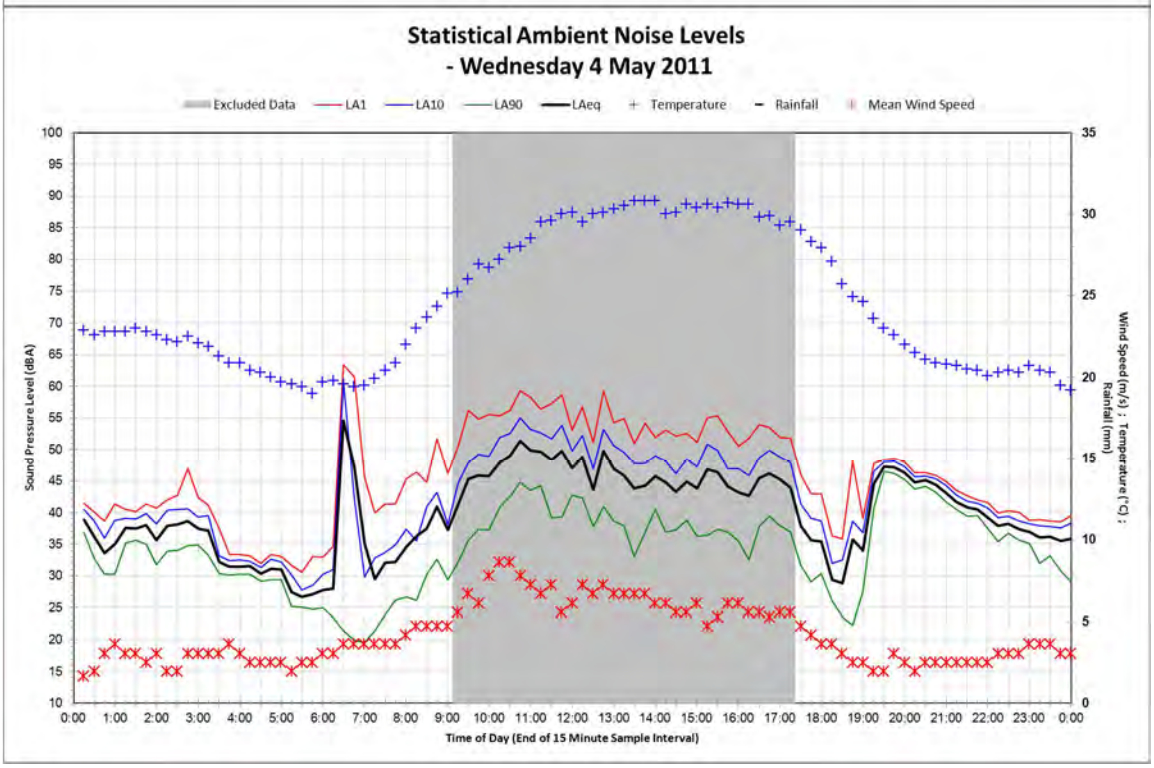

Statistical Ambient Noise Levels
- Tuesday 10 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

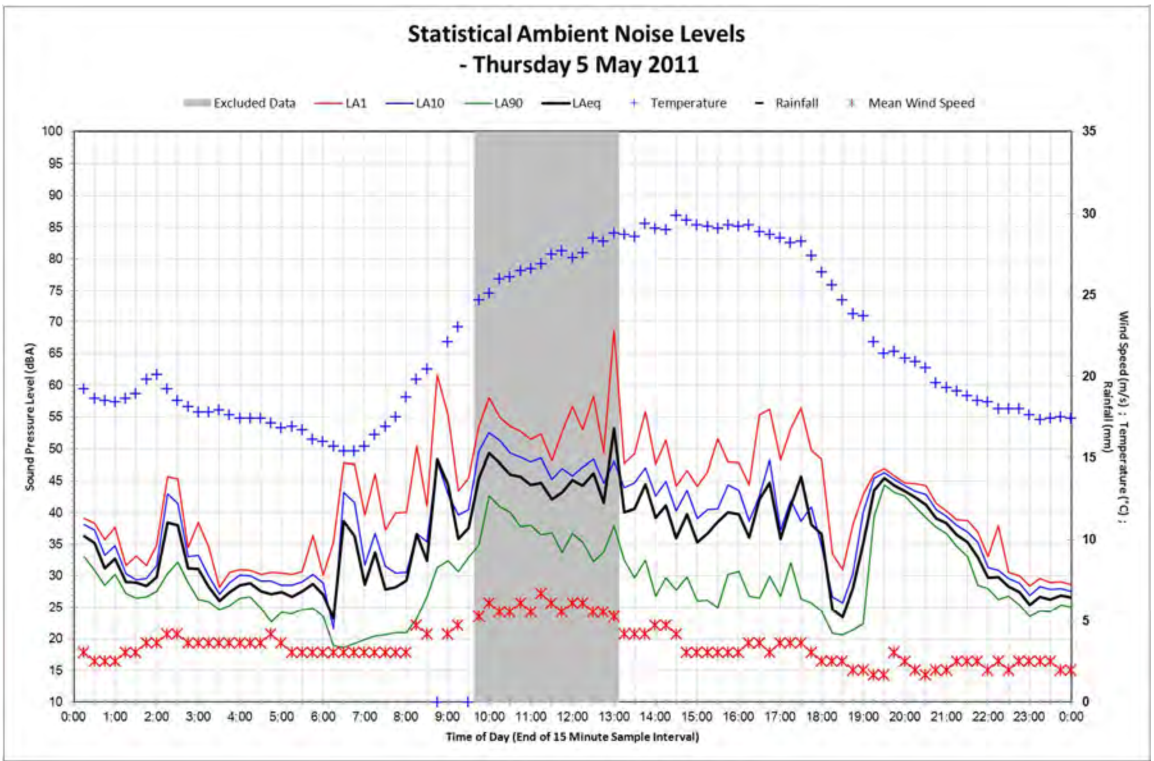

Statistical Ambient Noise Levels
- Wednesday 11 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

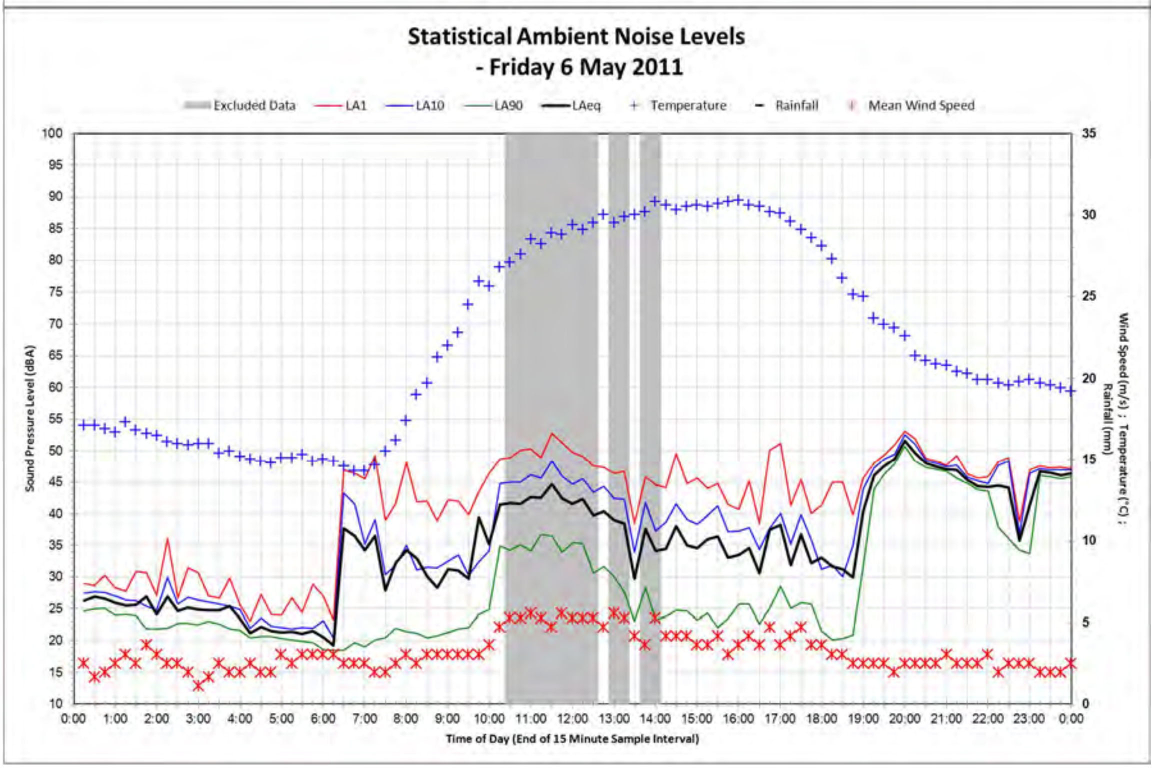

Statistical Ambient Noise Levels
- Thursday 12 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

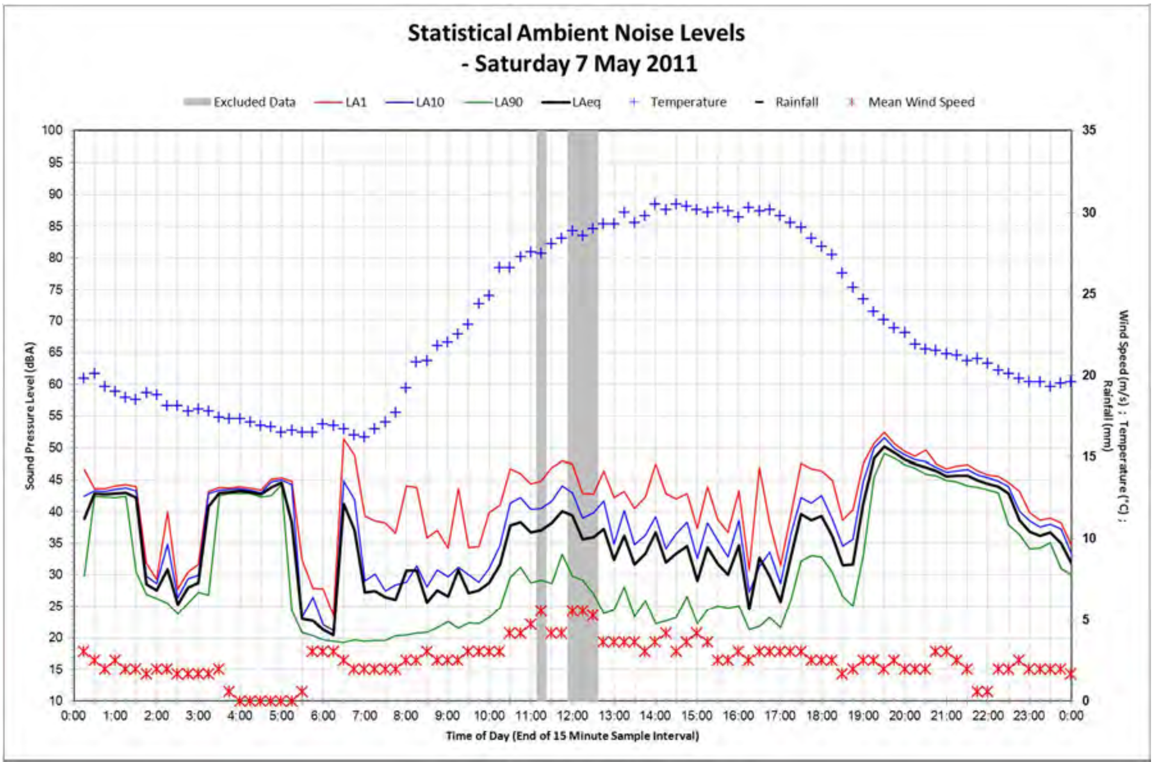
Logger 2

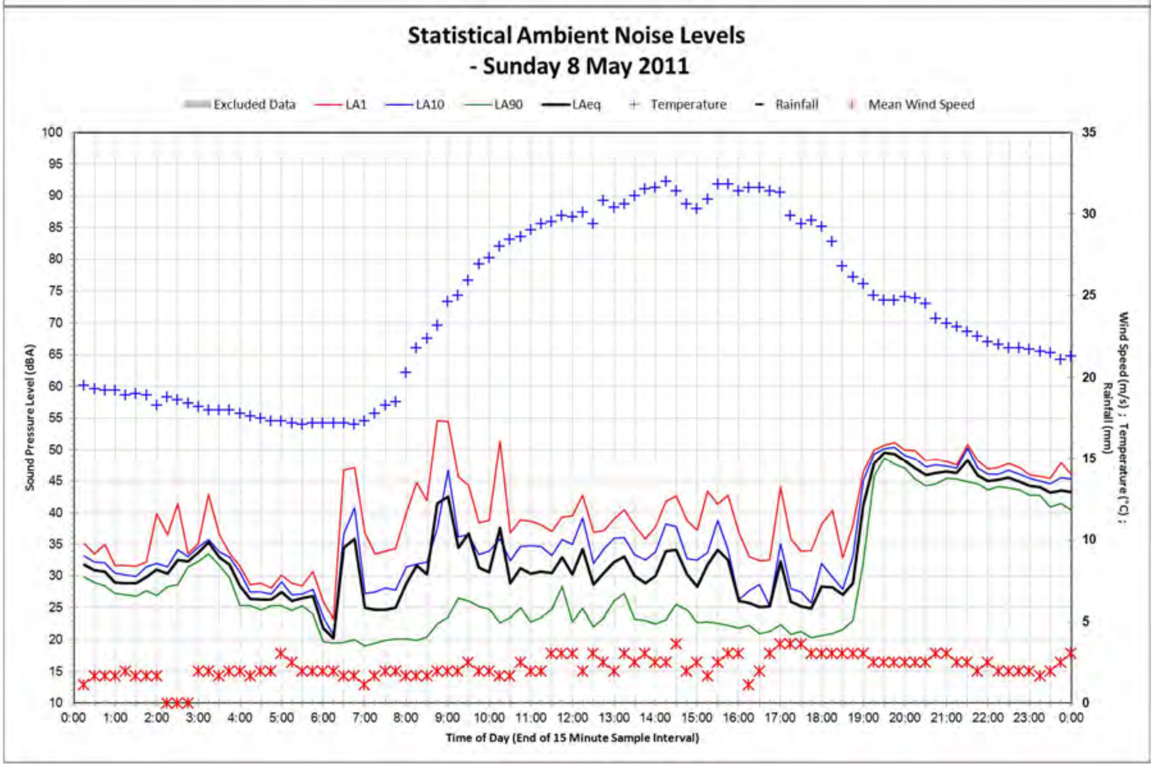

Statistical Ambient Noise Levels
- Tuesday 3 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

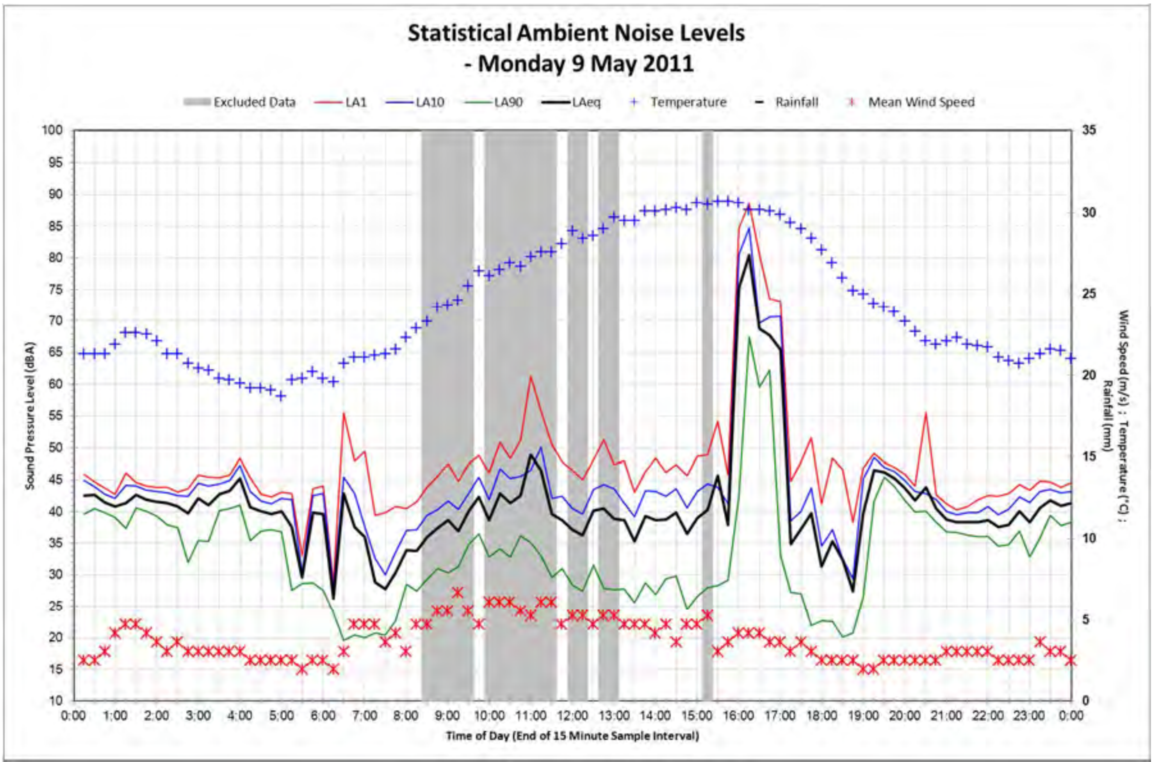

Statistical Ambient Noise Levels
- Wednesday 4 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

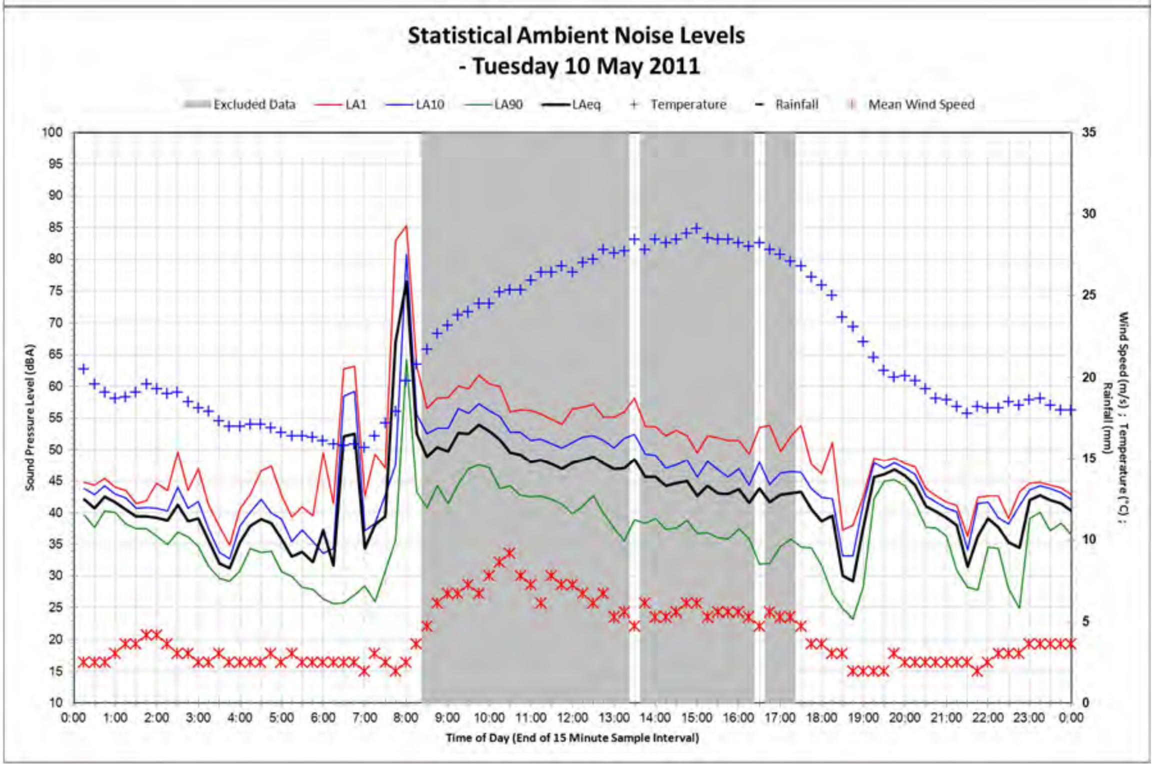

Statistical Ambient Noise Levels
- Thursday 5 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

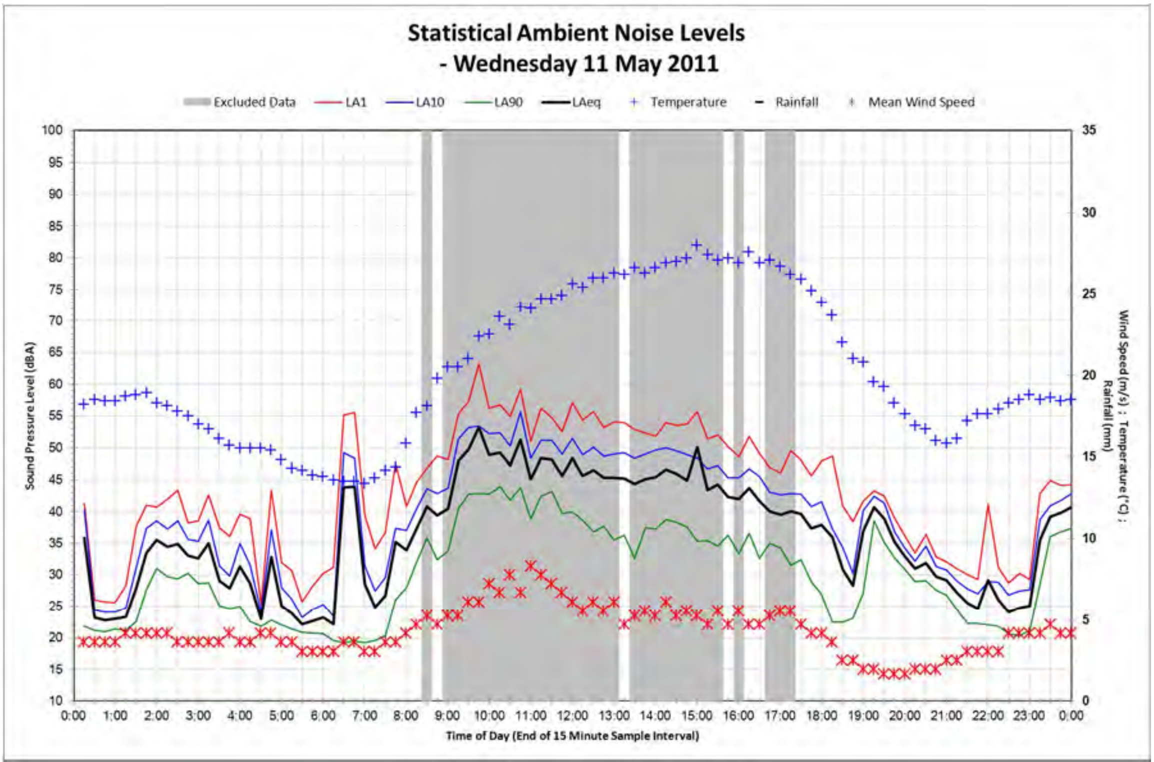

Statistical Ambient Noise Levels
- Friday 6 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

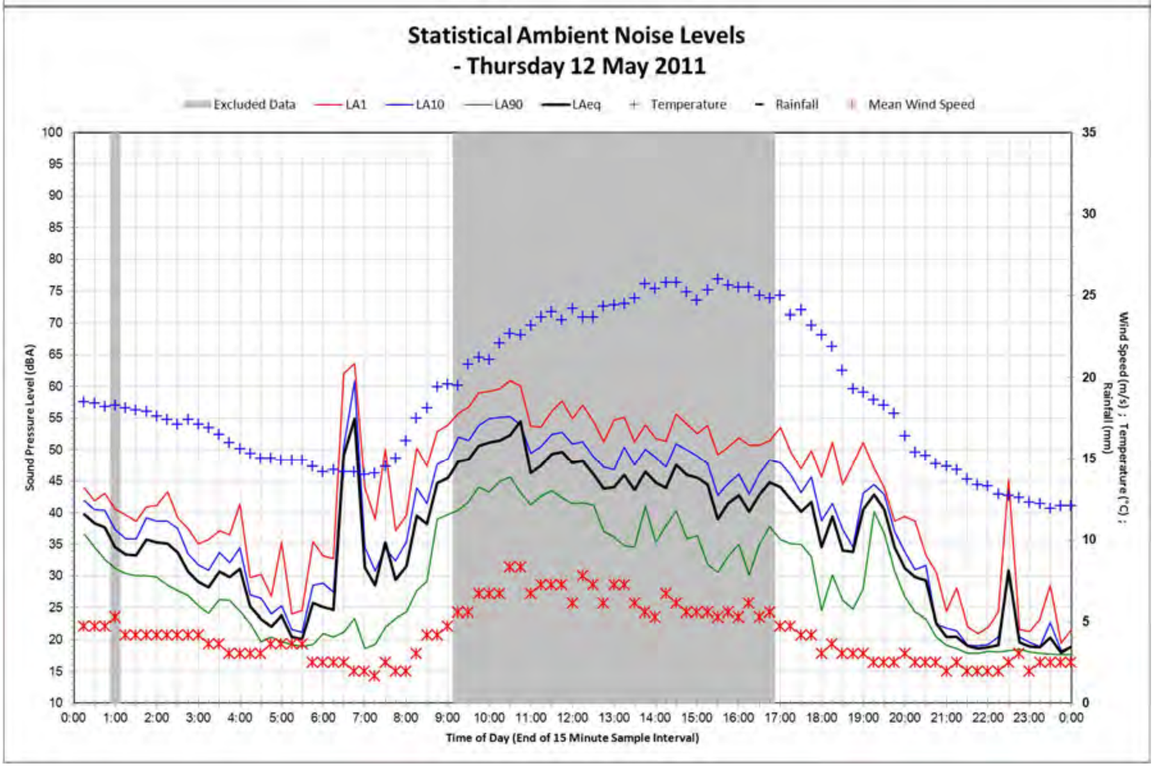

Statistical Ambient Noise Levels
- Saturday 7 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Sunday 8 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Monday 9 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Tuesday 10 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Wednesday 11 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
- Thursday 12 May 2011
Excluded Data
LA1
LA10
LA90
LAeq
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)

GHD

Level 5, 66 Smith Street
Darwin Northern Territory 0800
T: (03) 8687 8000 F: (03) 8687 8111 E: melmail@ghd.com.au

Document Status

Rev No.	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
1	S Gunawan	V Chavand	[signature]	I McCardle	[signature]	6/6/2013