

Statement of Acoustic Impact – Newcastle 500 Supercars Event

1. Introduction

It is understood that Archer Capital, the majority owner of Supercars, in conjunction with Destination NSW, is planning to facilitate and operate a Supercar Motor Race on a 2.6 km circuit around East Newcastle in November 2017. The acoustic impact from these passing race cars is considered to have the potential for permanent hearing damage to occur to residents; which includes young children, adults, the aged and people with disabilities.. To quantify the impact to affected Newcastle residents, predictive computer noise modelling was carried out to validate community concerns about exposure to excessive and continuous levels of noise.

2. Executive Summary

The proposed racing circuit in Newcastle East passes within 3.5 m of many residences. Results of computer noise modelling predict that these residents will be exposed to maximum sound levels of 109 dB(A) immediately adjacent to the track. Most directly affected residences will be exposed to between 105 and 107 dB(A) at their front doors. The results indicate that near continuous sound pressure levels could exceed 90 dB(A) inside living and sleeping areas. Worst-case predictions suggest sound levels could approach 100 dB(A) inside living and sleeping areas.

Sound exposures around Newcastle East peninsula will exceed 85 dB(A), with many areas exposed to levels greater than 95 dB(A). These sound exposure levels are well above the levels of concern for occupational noise. The race exposes residents not only to significant levels of harm and annoyance from noise, but will also disrupt communication, impact local businesses and potentially, cause structural damage to houses from vibration.

These sound levels cannot be mitigated and the exposed population cannot adequately be protected from harm. Therefore the only alternative is to relocate this proposed Supercar race from Newcastle to another more suitable purpose-built location.

3. Glossary

dB(A), A-weighted decibels, are an expression of the relative loudness of sounds in air as perceived by the human ear,

CAMS, Confederation of Australian Motor Sport,

Emissions, sounds emanating from a source,

FIA, Fédération Internationale de l'Automobile,

GIPA, Government Information (Public Access) Act 2009,

HMRA, Homebush Motor Racing Authority,

Immissions, received sounds at a receiver location,

L_{Aeq,8h}, the eight-hour equivalent continuous A-weighted sound pressure level in decibels (dB(A)) referenced to 20 micropascals, determined in accordance with AS/NZS 1269.1:2005 (Occupational noise management—Measurement and assessment of noise immission and exposure),

L_{C,peak}, the C-weighted peak sound pressure level in decibels (dB(C)) referenced to 20 micropascals, determined in accordance with AS/NZS 1269.1:2005 (Occupational noise management—Measurement and assessment of noise immission and exposure),

L_{A90}, background noise levels and is defined as the sound level just exceeded for 90% of the time,

L_{WA}, Sound Power level, the rate at which *sound* energy is emitted,

POEO Act, Protection of the Environment Operations Act 1997,

Supercar, refers specifically to naturally aspirated 5 litre V8 Supercars homologated through FIA.

4. Location

The proposed Newcastle East circuit passes within 3.5 metres of 9 historic apartment complexes, 26 non-historic apartment complexes, 68 historic residential terraces and 3 non-historic residential houses. The track also passes many business with direct street exposure, as well as Newcastle's regional police command centre and many office buildings. It passes within metres of several local and state heritage listed buildings or monuments. It also encloses 3 public housing complexes for aged residents. The circuit will require significant public works for both existing road upgrades as well as 300m of proposed new race track near Nobbys Beach.

5. Objectives and Guidelines

This report has assessed the predicted noise exposure levels from the Supercars race against the Safework NSW and Work Health and Safety Regulation 2011, which states the following exposure standards for occupational work place noise:

- a) $L_{Aeq,8h}$ of 85 dB(A), or
- b) $L_{C,peak}$ of 140 dB(C).

It is understood that the Supercar event is being managed by 'Destination NSW' and is under specific legislation (the *Motor Racing Legislation Amendment [Newcastle 500] Bill 2017*) for the duration of the event. It is also understood this legislation 'switches off' any jurisdiction of the EPA or the POEO 1997. However, it is relevant to refer to the POEO Act, because it covers offensive noise, which it defines as:

- c) That by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:
 - Is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or,
 - Interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or,
- a) That is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

6. Modelling Output:

6.1 Noise Contours

The noise model generates noise contours, or isopleths. These contours represent lines of equivalent sound pressure, in A-weighted decibels. These were generated in the noise model between 65 dB(A) and 100 dB(A) in 5 dB intervals. Where 65 dB(A) represents a point of clear audibility above typical urban background noise, or L_{A90} sound levels (which would be expected to be 45 – 50 dB(A) in this area), and above 85 dB(A) represents areas of immediate concern for hearing loss to an unprotected public. Noise contours expected during racing are presented in Figure 1. Methodology and data inputs are discussed in appendix A.

6.2 Received Sound Levels

As well as noise contours, the noise model also calculates received sound pressure level emissions in dB(A) at nominated receiver locations. Emission levels were calculated at 14 nominated receiver locations around Newcastle East. These locations are shown in figure 3. These 14 receiver locations were intended to represent a cross-section of receivers expected on the day. This included receivers adjacent to the track in grandstand areas, track and pit area officials, residential receivers both

directly exposed as well as those some distance away, those on the nearest beach and also immediately adjacent to the local Police Station (which is also Newcastle's command centre). To further ensure a conservative approach, racing cars were not always placed adjacent to receivers, particularly residences.

7. Results of Noise Modelling

Sound levels predicted from the modelling range from 78 dB(A) 218 m from the circuit to a maximum of 109 dB(A) immediately adjacent to the track. This level of unprotected exposure is acceptable for less than 2 minutes. Most directly affected residences will be exposed to 105 to 107 dB(A) at their front doors. These levels of unprotected exposure are acceptable for just 3 to 5 minutes. Sound exposures around Newcastle East peninsula will continuously exceed 85 dB(A), with many areas exposed to levels greater than 95 dB(A).

This assessment of the acoustic impact on the existing amenity from the proposed Supercar race in Newcastle confirms that the local community will be exposed to significant levels of noise during racing. It is understood this could be for up to 5½ hours per race day.

Given the very close proximity to many residences and the significant extent to which the general residential population of Newcastle East will be exposed to harm and offensive noise, a computer noise propagation model has been generated and represents actual anticipated race conditions. The results of noise contours are presented in Figure 1.

The predicted levels are well in excess of both Work Health and Safety Regulations for occupational hearing damage and the POEO Act for offensive noise annoyance.

8. Discussion

Given the age, poor sound level reduction (attenuation) and expected acoustic leakage paths of many of the affected buildings, some of which are heritage listed and with many ranging from 3.5 m to 5 m from the track boundary, the modelling results indicate that near continuous sound pressure levels could exceed 90 dB(A) inside living and sleeping areas. Two or more cars passing in close proximity will increase sound pressure levels by a further 2 - 3 dB. Worst-case predictions suggest sound levels could approach 100 dB(A) inside living and sleeping areas.

The CAMS 'allowable' limiting value of 95 dB(A) at a distance of 30 m is equivalent to a sound pressure level range of 115 – 120 dB(A) or more approximately 1 metre from just one passing car.

Note that the CAMS limit is the level CAMS feels is acceptable and has no correlation to any SafeWork NSW or EPA endorsed limit for any level of continuous noise exposure. It is simply a statement of how 'loud' each car is. This may be considered acceptable for a dedicated racing circuit environment, but is not acceptable in a residential area. This CAMS level correlates closely to the conservative sound levels used as sources in the computer model. This is not an endorsement, but simply confirms how loud the Supercars are.

This limit represents a complete failure to protect the general public and the community from significant harm. Additional simplified single point source modelling by others using only the CAMS values calculates that *maximum* sound pressures will be 113 dB(A) and that *average* sound pressure levels for 67 minutes per race will be 102 dB(A) 3.7 m from the track boundary¹.

Table 1 shows the predicted emission levels at the 14 receiver locations presented as receivers A to N in Figure 3. To ensure the acoustic impact of the race is representative, cars were modelled to represent continuous expected noise exposure.

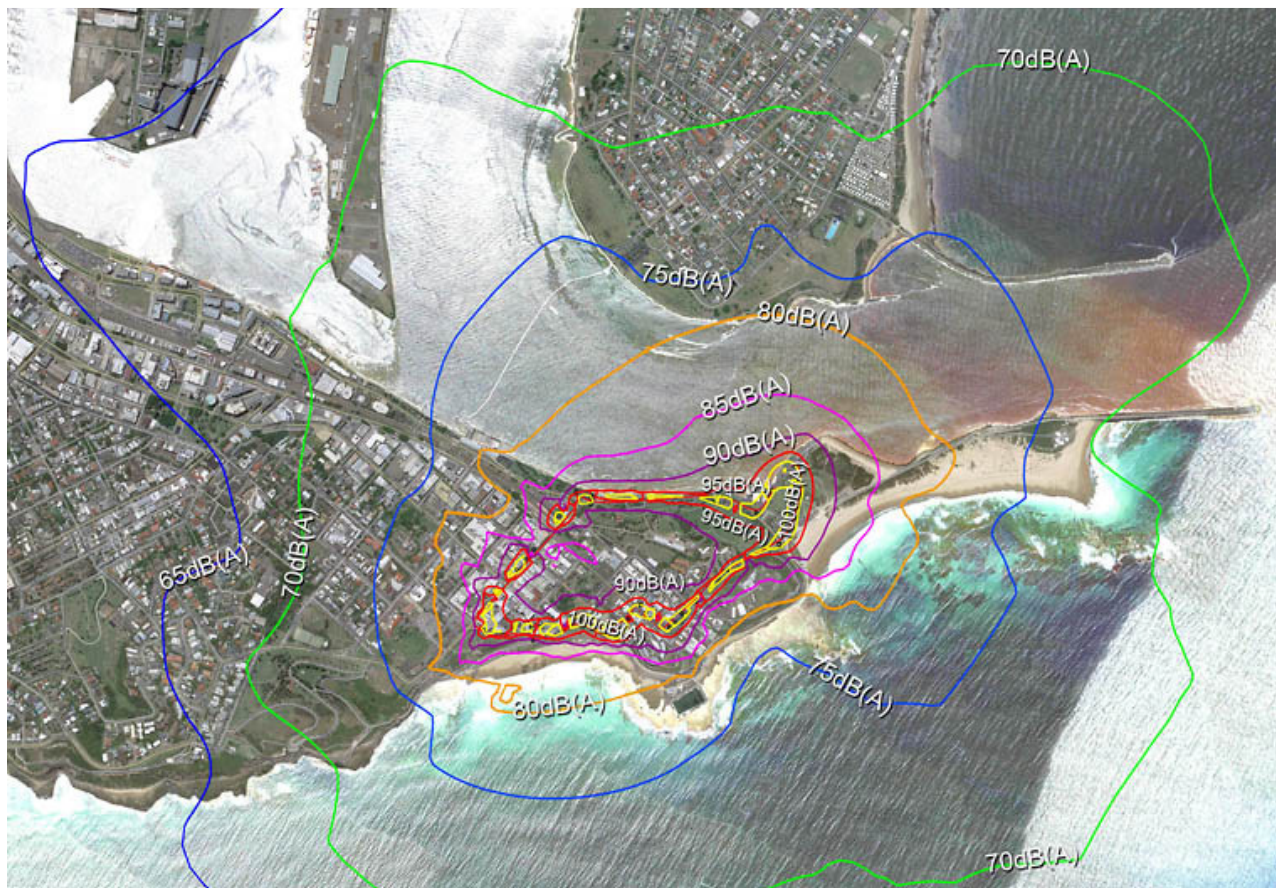


Figure 1: Noise contours showing sound level impact of Supercars during racing

Table 1: Sound level emissions during typical racing for 14 receivers represented around the track and in the community. These included race spectators, residents, beach combers, passers by, pit lane and track officials. Refer to Figure 3 for location of receivers.

1. Receiver A – 10 m from track – Pit Area	94 dB(A)
2. Receiver B – 100 m from track – Near Park Rail Sheds	88 dB(A)
3. Receiver C – 30 m from track – Fletcher Park Grandstand	98 dB(A)
4. Receiver D – 16 m from track – Outside Police Station, End Watt St	105 dB(A)
5. Receiver E – 6 m from track – Corner King And Watt St	100 dB(A)
6. Receiver F – 218 m from track – Corner Newcomen & Church St	78 dB(A)
7. Receiver G – 100 m from track – Newcastle Beach At Shore	84 dB(A)
8. Receiver H – 3 m from track edge – Boatmans Row, Nobbys Rd	101 dB(A)
9. Receiver I – 3 m from track edge – Nobbys Beach Carpark	107 dB(A)
10. Receiver J – 100 m from track – Shepherds Place Flats	93 dB(A)
11. Receiver K – 3 m from track – Horseshoe Bend Grandstand	107 dB(A)
12. Receiver L – 5 m from track edge – Corner Scott & Watt St	83 dB(A)
13. Receiver M – 30 m from track edge - Horseshoe Bend Grandstand	99 dB(A)
14. Receiver N – 3 m from track edge – Allan Apartments 30 Nobbys Rd	109 dB(A)

9. Health Effects from Exposure to Excessive Noise Levels

A literature review as well as a comparison to similar studies^{iv} was carried out to provide supporting evidence of similar sound levels. A Statement of Evidence for Land & Environment

court proceedingsⁱⁱ confirmed that sound pressure levels from passing V8 Supercars when measured at 30 m averaged 93 dB(A) with a maximum of 99 dB(A). This equates to an average of 112 dB(A) to a maximum of 117 dB(A) 3.5m away at property boundaries. These figures generally fall within the CAMS 'allowable' limit of 95 dB(A) at 30m *for a single car* and are higher than the results of this report's conservative predictive computer modelling approach. A 2007 independent studyⁱⁱⁱ on "The Combination of Workplace and Recreational Noise Exposure" concludes "While acknowledging that some spectators may be exposed to higher levels, it is reasonable to assume that a spectator at a range of motor sports activities could be exposed to an L_{Aeq} (average) of around 90 dB over the time of the (motor sport) event". These are exposure figures at 30 m or greater and equate to *average* continuous sound levels in excess of 105 dB(A) L_{Aeq} at property boundaries. These figures are for touring cars. Supercars would exceed these predictions.

These references, as well as additional sources of data indicate that expected sound levels could be significantly higher than those predicted by modelling by up to 9 dB, confirming the conservative nature of the modelling approach and the very real risk of permanent hearing damage to an unprotected population. Additional references and sources confirm that the predicted results from this predictive computer model are within expectations.

Further representative data is being sought from the EPA, from ADFA (Australian Defence Force Academy) and from other consultants. As part of the community consultation process carried out by HMRA, independent acoustic consultant Richard Heggies and Associates (now SLR Consulting) was engaged to conduct predictive noise modelling as well as environmental and track-side monitoring during V8 Supercar racing events at Townsville and Homebush. These specific reports^{iv} were requested from *Destination NSW* under the GIPA Act, but were refused on the following grounds:

- *Richard Heggies (the consultant) objected to disclosure of the reports, and,*
- *There is an overriding public interest against disclosure of the information.*

However, these reports^{iv}, originally available on the HMRA web site and subsequently obtained via an internet cache, confirm the validity of computer noise modelling as an accurate tool to assess noise exposure, as well as confirming the general range of expected sound pressure levels from the event, which agree closely with the results of the modelling presented in this report.

The presented data confirms that the expected sound pressure levels will be above objectives for safe exposure for the duration of racing, which will be up to 5½ hours per day for the 3 days of racing. All available data relating to expected levels of noise exposure during racing supports and at times exceeds the conservative predicted sound modelling results prepared as part of this report.

An exposure level of 109 dB(A) is the equivalent of 26 times the daily allowable noise exposure under current SafeWork NSW legislation. These extreme sound pressure levels are analogous to the loudest heavy metal rock concerts, jet engine noise at 100 metres and jack-hammers and chain saws at 1 metre. Significant current and historical literature, which is the basis of current legislation designed to protect exposed individuals from significant harm as a result of noise exposure, confirms this is likely to result in permanent noise-induced hearing loss to unprotected residents, even *inside their homes*. Recent report studies show that a loud sound event can cause permanent auditory nerve damage, even when sustained for only a matter of hours^v. There is no precedent for a Supercar race in such close proximity to residences anywhere in Australia and these sound pressure levels cannot be mitigated to such an extent as to make them safe for an unprotected public.

The most common association with excessive levels of noise exposure is the known causality between high noise levels and mechanical hearing damage and associated noise induced hearing loss. After prolonged exposure this can cause tinnitus, frequency loss and partial or complete deafness. However, recent studies^{vi} show that even when hearing recovers from brief excessive noise exposure (100 dB(A) for 2 hours) there is delayed and progressive loss of hearing cells over many months to years, even though some cells may recover normally. These published papers show that a single 100 dB(A) exposure has deleterious synaptopathic or neurodegenerative effects on the aging ear that continues long after the noise has stopped. In summary, significant noise exposure is

now considered to be more dangerous to hearing than previously assumed and current guidelines have not yet incorporated this new understanding.

Excessive noise exposure can also induce hypertension and ischaemic heart disease as well as sleep disturbance and cognitive impairment in children. It also produces annoyance leading to stress related symptoms and increases cortisol production, the stress hormone. This is discussed in detail in a comprehensive report produced by the World Health Organisation on the Burden of Disease from Environmental Noise^{vii}. In light of the WHO report, of graver concern is the increased stress, anxiety, depression and suicidal ideation in people with mental health problems^{viii}.

10. Other Council Approaches

For comparison, an assessment of the approach taken by two other Councils (Port Stephens and Goulburn Mulwaree) was reviewed. This shows that to reduce noise annoyance from recurring racing events, the approach was to limit racing noise to background +5 dB(A). These guidelines, which have also been adopted overseas^{ix}, are summarised in Table 2.

Table 2: Guidelines for Motor Sport		L ₉₀ Background – dB(A)	
Zoning	Land Use	Acceptable Limit	Extreme Limit
R1-R2 Residential Area	Residential	Day – 45 Night – 35	50 40
R2-R3 Residential Area on a busy road or near an industrial area	Residential	Day – 50 Night – 40	55 45

This approach was adopted for the Wakefield race track near Goulburn NSW^x. Port Stephens Council considered this approach but opted instead for an annual events ratio approach, which allocates penalty points based on noise exceedences at receivers. Note that for the Wakefield Park race track Noise Impact Assessment, the closest residences were 4.5 km from the circuit, not 3 to 5 metres as is the case in East Newcastle. By comparison, the closest residences to the Homebush track are approximately 560 metres distant. This further confirms the levels of noise exposure for the proposed Supercars race in Newcastle is completely unacceptable given the extreme proximity to residences. This is exacerbated by grave safety concerns following several serious recent crashes during Supercar racing^{xi}.

Given these expected existing background ambient sound levels (L_{A90}) around the majority of Newcastle, a preliminary assessment indicates the race will be easily audible above the existing background by between 5.5 and 10 kilometres away depending on topography and wind conditions. This means the race will be both clearly audible, and in the region of annoyance (of background + 5 dB(A)) at Mayfield, Waratah, New Lambton, Adamstown and Kahibah. The race is expected to be audible at Charlestown, New Lambton Heights, Jesmond and Warabrook.

11. Conclusions Based on This Modelling

Despite a lack of data being made available from representative bodies (Destination NSW, the EPA and V8 Supercars), noise level data for actual Supercars has been obtained from multiple alternative sources. Significant rigour and method has been used in this predictive computer modelling process

to ensure that the results are valid, representative and conservative. The results of the modelling confirms that the entire Newcastle East peninsula will be exposed to continuous levels of noise well in excess of 85 dB(A) for the duration of racing. In many cases, the closest residents placed under duress by this event will be exposed to noise levels up to 109 dB(A) at their premises, which may continuously exceed 90 to 95 dB(A) inside living and sleeping areas. These figures are conservative and may be 3 to 5 dB(A) higher. These levels of noise exposure exceed all safe levels as mandated by SafeWork NSW and cannot be mitigated by any practical type of noise barrier. This severely affects not only residents, but also emergency services, medical facilities and local businesses whom are unlikely to be able to conduct any business because communication in the worst affected areas will not be possible.

Employers also have a duty of care to protect staff from occupational noise exposure, which will be highly unlikely for operators of restaurants and cafés with direct street exposure. A predicted sound level of 105 dB(A) 16 metres from the local police station/ regional command centre could compromise operational security, since internal communications, such as radio and phone calls may be inaudible.

It is not possible to offer hearing protection to all affected residents, particularly infants and young children, the elderly or those with cognitive impairment and people with mental health issues. In many instances hearing protection cannot be properly fitted or managed.

12. Recommendations

Given that this proposed event is annual, a detailed study of *existing* background sound levels in the community should be carried out to allow the existing Rating Background Levels (amenity levels) to be quantified as per the INP (Industrial Noise Policy) to assist in fully understanding the effect of predicted noise on residential receivers. Similarly, independent predictive computer noise modelling specific to the Newcastle circuit should be carried out prior to the event to further understand the likely impact of the race on affected residents. This should be part of a Noise Management Plan to be developed by Government agencies and Supercars and should be made available to the community as required by Section 18 of the revised 2017 Motor Racing Legislation Amendment (Newcastle 500) Bill.

Whilst it is technically possible to reduce induction and exhaust noise from Supercars to limits that will not cause harm, it is well understood that this is a quintessential component for race-fans and spectators. However, whilst personal hearing protection might be possible for a portion of the exposed population, it is not considered a practicable or reasonable approach to managing noise exposure in this case because it is unsuitable for children or for the elderly amongst others, and must be fitted correctly by trained personnel. Therefore because the sound levels cannot practically be mitigated and the exposed population cannot adequately be protected against the predicted sound exposure levels, the only reasonable alternative is to relocate this proposed Supercar race from Newcastle to another more suitable purpose-built location. All building works related specifically to this event, which will also add to unnecessary levels of noise annoyance, dilapidation damage and have their own detrimental impact to amenity, should cease immediately.

Appendix A - Background to Noise Modelling

12.1 Description

Computer noise modelling is a mathematical prediction of Sound Pressure Level immissions (received noise, or what is heard) in decibels dB(A), based on emission sources at known locations (the race cars).

12.2 Modelling software Package:

ENM (Environmental Noise Model), which is an EPA approved and validated computer noise modelling package. Being *validated* means that the sound levels predicted by ENM have been verified many times by attended sound level measurements. This includes a potential level of error, typically with results within ± 3 dB of what is predicted.

12.3 Required input data:

- DEM (Digital Elevation Map) or ground topography, which is available via data.nsw.gov.au as well *Department of Lands* and other sources. This topography for Newcastle East is shown in Figure 2. Note that buildings were not able to be modelled. The effect of buildings would decrease some sound levels when buildings act as barriers to more distant receivers, and increase other sound levels where acoustic reflections occur. Where direct line of sight occurs, which represents all directly affected residences, buildings increase sound level exposure because of the reflected sound.
- Octave band frequency spectrum information is required for the model and was adapted from actual Supercars measured at an Australian race track by acoustic consultants using calibrated sound level measurement equipment. It is important to use frequency spectra from V8 Supercars and not other race cars; such as touring car, rally or Formula 1 as each car's frequency signature affects noise propagation,
- Supercar sound pressure (loudness) data was obtained from sound pressure levels of various actual V8 Supercars from published literature, from race track measurements by others and from data obtained from other acousticians. All V8 Supercars are front engine rear wheel drive naturally aspirated 5 litre V8's homologated through FIA, Fédération Internationale de l'Automobile, typically producing between 460 and 485 kW.

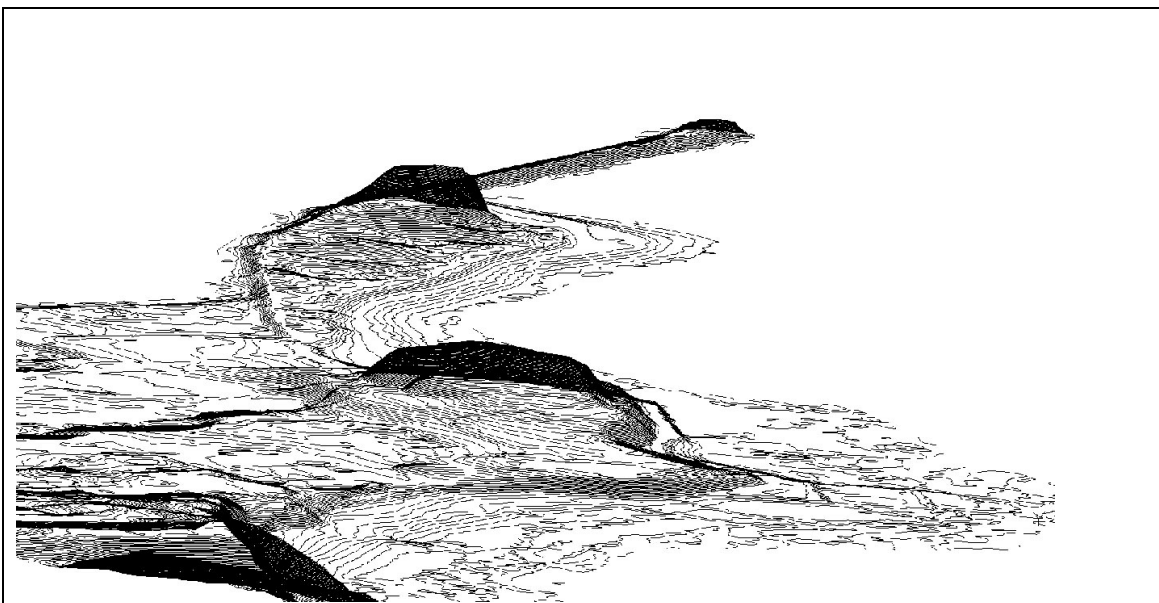


Figure 2: Digital Elevation Map of ground topography for Newcastle East peninsula, view due North.

- V8 Supercar sound pressure levels, in dB(A), were converted to unweighted linear decibels (dB), and then converted to a Sound Power Level, L_{wa} . The sound power level used is 3 dB lower than comparable data for V8 Supercars measured at Wakefield race track. This further confirms the data used in this modelling is conservative.
- Note that other sources of noise typical during the race period racing have not been included, these include helicopters and more importantly for occupational noise exposure of patrons, Public Address systems. These are normally placed behind spectator areas on poles and are typically adjusted to be 10 decibels above the expected background sound level. For much of the race, this could equate to continuous PA system music and commentary in excess of 100 dB(A) in prescribed spectator areas. It is also understood that off-shore V8 powerboats may be racing concurrently. These boats can produce Sound Pressure Levels of 118 dB(A) 60m away. This will further add to general noise exposure levels.

12.4 Assumptions:

- Atmospheric conditions affect sound. These were assumed to be stable, 20°C, 65% RH, with no wind and no inversions (a normal adiabatic lapse rate),
- Cars were then placed around the track to represent a Supercar race. This is shown in Figure 3. This is to represent real racing conditions.
- Cars were modelled at their average maximum sound level. This represents the average energy equivalent averaged over 15 minutes ($L_{Aeq,15}$) as required by the NSW Industrial Noise Policy to monitor environmental noise.
- The track is approximately 2.6 km in length. Cars are expected to complete this length track in less than 70 seconds at an average speed of 140 kph. Any stationary receiver will be passed approximately 87 times per 250 km race, or 385 times assuming 4½ hours of racing. This means exposure to worst-case sound levels is near continuous and the results of the modelling assessment are considered representative to assess the likely hood of harm to an unprotected public.



Figure 3: Location of receivers to determine received sound immission levels,

12.5 References:

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- ⁱ A.T.Spathis, An Independent Sound Pressure Analysis for Motor Sport of the Newcastle 500 V8 Supercar Race.
- ⁱⁱ Wilkinson Murray's Statement of Evidence for Land & Environment court proceedings No. 11328 from 2004.
- ⁱⁱⁱ Williams, W. and M.Burgess (2007). The Combination of Workplace and Recreational Noise Exposure. Acoustics Australia, Vol. 35, No.3, 91-95.
https://www.acoustics.asn.au/journal/2007/2007_35_3_Williams_Burgess.pdf
- ^{iv} Heggies Pty Ltd (now SLR Consulting); 'Sydney Telstra 500 V8 Supercar Noise Investigations', Report: 10-8136-R1, and 'Sydney Telstra 500 V8 Supercar Noise Monitoring', Report: 10-8136-R2.
- ^v Kujawa, S.C. and M.C.Lieberman (Lieberman, Adding Insult to Injury: Cochlear Nerve Degeneration after "Temporary" Noise-Induced Hearing Loss. J.Neuosci. 29(45):14077-85.
- ^{vi} Fernandez, K.A., Jeffers, P.W., Lall, K., Liberman, M.C. and S.G.Kujawa (2015). Aging after Noise Exposure: Acceleration of Cochlear Synaptopathy in "Recovered" Ears. J.Neuosci. 35(19):7509-20.
- ^{vii} World Health Organisation for the European Commission 'Burden of Disease from Environmental Noise' ISBN: 978 92 890 0229 5.
- ^{viii} Mental Health Medical Staff Council Position Statement 2017, Hunter New England Health.
- ^{ix} C.Menge, Harris Miller & Hanson Inc. Massachusetts. From Noise-Con 2008, 'Effective and Cooperative Noise Abatement Implementation at a New Racetrack'
- ^x Dick Benbow and Associates, Wakefield Parkway Noise Impact Assessment, 25/1/93.
- ^{xi} <http://www.news.com.au/sport/motorsport/v8-supercars/supercars-launches-investigation-after-15-tyre-blowouts-turn-phillip-island-500-into-a-farce/news-story/b2f06e078cd4294430380ed64d5771fe>
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