CONSULTANT ADVICE

Project:	Hanmer Springs Flyride	**Document No.:**	Ca 002 R01		
To:	Hurunui District Council	**Date:**	16 September 2021		
Attention:	Kelsey Bewley	**Cross Reference:**	N/A		
Delivery:	Email	**Project No.:**	20210485		
From:	Gary Walton	**No. Pages:**	10	**Attachments:**	No
Subject:	Noise Assessment Peer Review (RC210098)				

Marshall Day Acoustics (**MDA**) has been engaged by Hurunui District Council (**HDC**) to conduct a peer review of the Assessment of Environmental Noise Effects[1] (**the report**) prepared by Acoustic Engineering Services (**AES**) for the proposed Hanmer Springs Flyride development.

This report was subject to an addendum[2] and we have also considered this information in our review. We understand that the revised resource consent application lodged in June 2021 did not result in any changes to AES's assessment, and hence that their original report of December 2020 has not been modified.

This document summarises our review of the report, the application in general, and any submissions that are related to noise. For assistance, we have also included a glossary of acoustical terminology relevant to the application at Appendix A.

Summary

Our review is summarised as follows:

- We generally agree with the assessment methodology detailed in the report.
- We accept the assertion that noise from the ride system itself will have a less than minor effect.
- 'Vocalisations' will the dominant noise source and the level assumed in the calculations seems suitably conservative (i.e. it is at the upper-end of what might be expected).
- We agree that the District Plan noise limits will not adequately capture the potential noise effects.
- We therefore agree with AES's suggestion that 45 dB L_{AFmax} is an appropriate guideline to evaluate effects from the activity.
- Noise effects will be determined by how frequently high-level vocalisation events occur, but are unlikely to exceed the 'minor' threshold at the closest dwellings. We accept AES's position of a less than minor effect overall.
- AES's additional analysis has identified that further mitigation may be required beyond that described in the report, in the form of extended speed control zones on the ride.
- Submissions raise specific issues with parking and recreational use of forest area, which are not addressed in detail in noise report.
- We have not necessarily identified any significant potential adverse effects in relation to these, but the submitters may benefit from further consideration of these points by the Applicant prior to the hearing.

[1] Acoustic Engineering Services, File Ref: AC20335 - 02 - R1, dated 23 December 2020.

[2] Addendum prepared by Response Planning Consultants Ltd, dated June 2021.

ASSESSMENT REIVEW

General agreement with the report and conclusions

The standards and guidelines referenced, and the resulting calculation process are all appropriate for the project and are consistent with the methods that we would apply if doing the work.

The measured ambient noise levels, though just a brief 'snapshot' of activity in the area, appear reasonable given our knowledge of the area. Details are not provided on weather conditions during the survey, but a review of historic records show that conditions at the time of the survey should be representative of a typical summer's day, when the ride is likely to be at its busiest.

System-generated noise will be minimal

From the publicly-available information on the ride system – which will include noise from the trolleys and electric motors – AES's understanding that 'only low levels of noise' are generated seems reasonable. From our review of similar activities, we have not been able to find any examples of system-generated noise that would be problematic above the level of people noise assessed in the report.

We therefore accept the assumption that these sources will have a less than minor effect.

Noise from ride users is the dominant source

The assessment is based on 'vocalisations' (e.g. screams, shouts, etc) with noise levels derived from AES's measurements at a local hydroslide, referenced against literature. This source of noise is unusual in the context of environmental noise assessments. As such, there is a relative paucity of data and, arguably, no single 'correct' determination of noise source levels.

A detailed breakdown of source data obtained has not been given, but the assumed level of '118 dB L_{wAFmax}' seems to be reasonable. Based on our own measurements and research, this level is at the upper end of what might be expected and is therefore a conservative basis for the assessment.

There will be significant variation in noise between users and even between the same user at different times. Therefore, in practice, even if the maximum number of assumed vocalisation events do occur, the overall time-averaged noise levels may be lower than those predicted.

The report suggests that a female voice source is assumed. We note that a male voice may produce more energy on an overall basis (by around 7 dB)[3], while a female voice will typically have more energy at mid/high frequencies, as indicated in the report.

Given that the assumed maximum level is conservative for both male and female speakers, we expect that the modelled source noise levels are appropriate.

The District Plan limits are not appropriate for an unusual noise source

While relevant to assess compliance, we strongly agree with AES's view that the District Plan limits are 'not suitable' to adequately assess potential noise effects from the activity (report section 2.6). Even with the application of an adjustment to account for special audible characteristics (**SAC**, as defined in NZS 6802:2008), the hourly averaging of noise to assess against the 55 dB $L_{Aeq\,(1\,hr)}$ District Plan noise limit will not represent the impulsive peaks in noise from the activity. In addition, the District Plan places no control on daytime maximum (L_{max}) noise emissions.

The alternative 45 dB L_{Amax} guideline is appropriate

The assessment does not propose this as an absolute noise limit on the activity. Instead, we understand it is intended to represent the 'tipping point' beyond which adverse noise effects may become apparent.

[3] For example, from research by Cushing et al *"Vocal effort levels in anechoic conditions"* Applied Acoustics Vol. 72, 2011.

AES state that noise effects will be 'minimal', based, in part, on how a level of 45 dB L_{AFmax} will compare with the ambient noise level from other sources – broadly measured by AES as being on the order of 40 dB L_{Aeq} and 55 dB L_{AFmax}.

While we agree that 45 dB L_{AFmax} is an appropriate assessment guideline for the project, the effects of noise at this level will not necessarily be 'minimal', which could be interpreted as 'negligible' in RMA terminology.

Rather, as the character of the noise is likely to be markedly different to other ambient noise sources, we expect that it will be audible where the L_{max} noise emissions are greater than the background (L_{90}) noise levels, which are likely to be below 40 dB L_{A90} at most times. Given this difference in character, we consider the 45 dB L_{AFmax} criterion to be an acceptable balance between maintaining residential amenity and enabling development, but would expect noise effects to be minor or less than minor at the closest dwellings.

The exact scale of effect would be determined by how often noise events were at or above 45 dB L_{AFmax}. We consider that infrequent occurrences would result in a less than minor effect, while this would become a minor effect if events were more frequent.

AES have since advised us that they would consider the noise effects to be less than minor and we consider this acceptable, noting the level of control that operators have over the ride speed, etc.

CALCULATION OUTCOMES

Noise is unlikely to comply with the District Plan limits

Firstly, in relation to the average noise level calculations for assessment against the District Plan noise standards, the calculations seem appropriate and we agree that compliance is unlikely to be achieved at all times at the western and northern site boundaries (as identified in Figure 3.2 of the AES report). We consider this a technical non-compliance, noting that the unsensitive rural zone boundary is so close to the ride area.

Concerns with the modelling have been addressed

Based on the calculation detail presented in the report, we had some initial concerns that they may not be sufficient to fully account for the potential range of noise effects. We have discussed these details with AES and a summary of the discussion is provided in Appendix B.

The issues have been resolved to our satisfaction and are summarised briefly below:

- We queried whether trolleys' speeds can be limited on, and within, specific sections of the ride.
    - AES responded affirmatively that they understand that the trolleys have an onboard position system and autonomous braking.
- Our review of publicly available elevation contours suggested they may not represent the terrain between the site and closest dwellings with sufficient accuracy.
    - AES advised that a detailed LiDAR survey was commissioned by the client and the calculations were based on 1m vertical resolution points.
- We noted that calculations presented at ground level may not represent noise levels at upper storeys of dwellings.
    - AES have conducted further analysis, also noting the recent change in proposed tower heights, and confirm that, some further mitigation may be required (discussed below).
- Following on, the calculated levels at 17 Oregon Heights are particularly close to the 45 dB L_{AFmax} guideline and therefore would be most sensitive to any changes relating to the above.
    - AES's updated analysis shows that increased speed control zones may be needed near the final ride section, potentially also with some mid-ride control around 'Tower D'.

SUBMISSIONS

Many submissions raise noise as a general concern, which is covered in the noise assessment. Specific comments on aspects of the noise report would be best addressed by the Applicant prior to the hearing.

Site Access

Car Parking

The potential vehicle noise from parking is questioned by multiple submitters. This is not dealt with in the report, which simply notes that it is *'already part of the existing environment'*.

Novogroup's Parking Assessment, which was produced after the noise report, anticipates a peak hour parking demand of 23 vehicles. The assessment notes that these are most likely to park on Conical Hill Road, Oregon Heights and Thomas Hanmer Drive. Given the likely spatial distribution of this additional parking, it is unlikely that sufficient additional noise would be produced that would exceed any common noise level guidance (noting that the activity is not controlled by the District Plan noise limits). The Applicant may wish to present a specific analysis of this prior to the hearing in order to respond directly to submitters' concerns.

Pedestrian Access

Similarly several submitters note that additional noise from people walking towards the start of the track is also of concern and has not been assessed in the report. As above, it appears unlikely based on the information available that the extra noise alone would be a notable effect in terms of the change in noise level. However, if the number of passing events becomes more frequent then locals may perhaps notice an increase in the general use of the area that could increase their perception of pedestrian noise.

Noise arising from use of the Acheron Heights access way is also identified as a concern. The Parking Assessment states that parking is not anticipated along this road for various reasons, including that use of this road is not intuitive for the general public and people outside of the area will not be aware that the track can be accessed via this no-exit road. Accepting these points, then use of the walking connection through 34 Acheron Heights is only likely to be by locals with little total increase expected.

Recreational Users

Some submissions express general concern on the effects of noise on recreational users of the forest area and Conical Hill walking tracks. In terms of general recreational use, no specific protections exist in the District Plan and we note that there is no noise standard for open areas in the rural zone, as the noise limit only applies at dwellings.

The report generally does not discuss recreational users, but does note in Section 3.2 that *'noise levels of up to 65 dB L_{AFmax} are expected over a small portion of the Conical Hill summit pathway'*, but that they *'do not expect this … to have any adverse effect'*.

Most guidance on recreational areas in New Zealand focusses on national parks and Department of Conservation land. From our previous research, studies have found that 'back-country' visitors consistently show greater sensitivity to sounds than 'front-country' visitors (i.e. those who may use easily accessible lookouts etc.). Visitors to the town-facing areas of the walkway are likely to be relatively accepting of noise, noting their proximity to an urban area.

For areas further afield, any readily identifiable noise has the potential cause annoyance to some 'quiet' recreational activities. In order to have no effect, noise from the activity would have to be inaudible, which will generally only occur when the maximum (L_{max}) noise level is below the background (L_{90}) noise level. We expect that background noise levels in the forest area will be between 20 and 40 dB L_{A90}, depending on weather conditions. As such, based on extrapolation from the noise contours in the report, vocalisations could be audible out to Clarence Valley Road to the west under some conditions. The scale of effect from this will vary but we do not anticipate it to be more than minor given the frequency of the events.

Horse Riding Tracks

Submission 7, from *Hanmer Springs Horse Riders Inc.* discusses the potential for horses using the local recreational tracks to be spooked by sudden noise from the activity overhead. There is a lack of specific research on this topic, so we cannot simply and objectively quantify the extent of this issue.

Much of the existing research is focussed on horses' sensitivity to noise sources such as aircraft overflights and suggests that horses can quickly normalise to such noise when in familiar surroundings. However, this may not hold true for a walking track they use infrequently. An equine behaviour specialist may be able to help quantify the risk, although this may amount to no more than expert speculation.

We suggest that Council engage with the society to determine how frequently nearby tracks are used and the proximity of riders to the proposed activity. We note that the society's suggestion to establish an alternative horse-riding track would be suitable mitigation to reduce this hazard, but Council would have to determine if it was the best practicable option.

The closest point between the track and the proposed ride is adjacent to Tower 6 (Tower 'F' in the noise report), with a separation of around 50 metres. The noise assessment suggests levels of 70-75 dB L_{AFmax} at ground level at this distance. At this level, noise from vocalisations will be clearly audible over the background noise level to the human ear. However, we also note that there will be some existing levels of impulsive noise in the environment – for example from mountain bikers and walkers, along with natural sounds such as birds – that would have the potential to occasionally generate similar levels.

Night Flights

The submissions from W. Smith (#17) and J. & N. Rogers (#31) reference the possibility of 'night flights' in the future. We are not aware that this is proposed at this time, with the application noting that this may be addressed as part of a future variation (paragraph 27).

This has not been considered in the noise assessment, which assumes operations will be limited to the daytime period in the Hurunui District Plan (0700 to 1900 hrs). Any operation outside of these times would not be appropriate before any further assessment is undertaken.

17 Oregon Heights

C. Conaghan (Submission 47) addresses the discussion in the noise addendum regarding noise received in his outdoor area, and notes that this is situated on the north side of the dwelling and was not assessed by AES. He also suggests that the imposition of noise limits would be appropriate.

As suggested in the noise report, it may be difficult to define a simple and appropriate performance standard for the purpose of protecting amenity. However, we agree that at the least, measurements should be conducted once the ride is operational to verify that noise emissions are in accord with those estimated in the application.

In this regard, AES may wish to interrogate their model further to get an accurate estimate of noise anticipated in the outdoor area of 17 Oregon Heights, now that they are aware of it.

Mental Health

In addition to general noise concerns covered above, A. Brower (Submission 55) discusses concerns around screams inciting a stress response, associated with post-traumatic stress disorder. Other submissions also raise mental health concerns.

This is a good example of why the normal District Plan noise limits are not appropriate to fully capture the potential noise effects from this activity. The noise report (Section 2.5) discusses the potential emotional response to screams.

The potential or actual mental health effects from noise on susceptible members of the community is outside our area of expertise. However, we understand that responses can be different depending on an individual's particular set of circumstances. What we can say is that potential noise effects will be greatest for those

dwellings closest to the activity and will be reduced both by screening (provided by dwellings or other structures) and by distance to much of the residential area, noting that high frequency noise is relatively efficiently attenuated over distance compared with noise at lower frequencies.

APPENDIX A GLOSSARY OF TERMINOLOGY

Ambient	The ambient noise level is the noise level measured in the absence of the intrusive noise or the noise requiring control. Ambient noise levels are frequently measured to determine the situation prior to the addition of a new noise source.
A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
Hertz (Hz)	Hertz is the unit of frequency. One hertz is one cycle per second. One thousand hertz is a kilohertz (kHz).
$L_{A90\,(t)}$	The A-weighted noise level equalled or exceeded for 90% of the measurement period. This is commonly referred to as the background noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
$L_{Aeq\,(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
Masking Noise	Intentional background noise that is not disturbing, but due to its presence causes other unwanted noises to be less intelligible, noticeable and distracting.
Special Audible Characteristics	Distinctive characteristics of a sound which are likely to subjectively cause adverse community response at lower levels than a sound without such characteristics. Examples are tonality (e.g. a hum or a whine) and impulsiveness (e.g. bangs or thumps).
SPL or L_P	Sound Pressure Level A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μPa RMS) and expressed in decibels.
SWL or L_W	Sound Power Level A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.

APPENDIX B CORRESPONDENCE REGARDING MODELLING

Gary Walton

From: Jeremy Trevathan <jt@aeservices.co.nz>
Sent: Tuesday, 22 June 2021 16:12
To: Gary Walton
Cc: Oliver Hutchison
Subject: RE: Hanmer Springs Flyride Review
Attachments: Photo showing 17 Oregon Heights north facade.jpg

Hi Gary,

As discussed on the phone just now, please see brief responses in red below.

Regards,

Jeremy

Jeremy Trevathan
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From: Gary Walton <Gary.Walton@marshallday.co.nz>
Sent: Wednesday, 16 June 2021 4:47 PM
To: jt@aeservices.co.nz
Subject: Hanmer Springs Flyride Review

Hi Jeremy

I have finally had a chance to look at this, which seems like good timing as I understand that there has recently been an addendum to the application. I believe that there was this didn't result in any extra work on your part, so I assume the information I received at the time of application is still the most relevant.

I've worked through the report and generally agree the proposal looks ok, but a few questions did come to mind, as below.

1. Speed control

Regarding the recommendation to limit 'fun' (for want of a better word) on the final two spans, what is your knowledge of the ride system? Can the trolleys be speed limited for specific sections, or would any limit only be an absolute for the whole course? Otherwise, is the only way of limiting speed on these spans through the actual design (i.e. span gradient, etc.)?

Should the former be possible, then I note that it would be possible to adjust this over time in response to any complaints (or lack thereof). If not and it's just an inherent feature of the design, then I expect future modification would be impractical.

We understand that it is possible to adjust speed for specific sections of the course. The trolleys have an onboard positioning system, and an autonomous braking system, so they can be programmed to speed up and slow down based on the position of the trolley on the course.

2. Topographic data

What data was used for the modelling? Based on the noise contours provided and with reference to the visual assessments, it appears that the noise levels in the residential area to the south are highly dependent on screening from the ridgeline running south-west/north-east through the final span and end section.

From my brief review of the basic 20m topographical elevation contours, for example, it appears that these may not be a good representation of the land between the end of the ride and the closest houses. However, I could not immediately see any publicly available LiDAR data available for this area. Did the model rely on other information provided by the Applicant or was consideration given to this aspect by other means?

The topographic data used was sourced from the client. It was based on an aerial lidar survey commissioned by the client, and completed by Landpro Ltd. The data was imported into SoundPLAN as elevation points at 1m vertical resolution. The surveyed area extended beyond the nearest dwellings.

3. Noise contour heights

Somewhat related to the point above, I am concerned that assessing noise in the residential zone through the 1.5 m height contours alone may not be sufficient. The two closest existing dwellings – 17 and 24 Oregon Heights – both appear to be two-storey. Similarly, any new dwellings at 19 or 26 Oregon Heights could well be expected to be multi-level.

The gradient of the hill appears to be sufficiently steep based on the 20m topo contours above that a receiver at 1.5m in height may be at least partially screened from the point sources near the ridgeline, while one on an upper floor would have potentially a clear line of sight. Noise levels experienced at the dwellings may therefore be higher than anticipated based on the noise contours alone.

See below.

4. Point source placement

Following on, the contours at Figure 3.2 show that 45 dB L_{AFmax} is just achieved at the façade of the dwelling at 17 Oregon Heights. This level may not be achieved if the assessment height were raised, or potentially if the scream event (point source) occurred closer to the final tower.

Interesting questions. A few observations:

- In terms of 45 dB LAFmax – as presented in our report we see this as an indicator of emergence of a possible effect, based on the ambient measurements in the vicinity of Oregon Heights. At or below this level the ride sound will be similar to the average ambient levels already present, and comfortably below other regularly occurring 'Lmax' events – and so we would expect sound at this level to have a less than minor adverse effect, even if occurring relatively frequently.

- As discussed the issue of noise received at the second level of a building is as interesting one. We had been thinking of the 45 dB LAFmax as a suitable indicator for possible effects in outdoor areas. As far as we can see neither of the two closest existing dwellings have outdoor living areas above ground floor level on the north side (i.e. balconies). Image of #17 Oregon Heights attached (bottom right in photo). This may be because shading from the hill does not encourage outdoor living in this direction.

- As you know there are a number of assumptions which go into producing a specific modelled scenario – in this case the sound power, location and height of the source (even when the tower heights are fixed a variable is how the track will be configurated and so how far below the tower height a person's head will be at each point on the ride). All of that means the specific modelling outcome in this case is just indicative – but is a useful guide when considering the general magnitude of what may occur, in the context of the existing ambient environment. As you pointed out, the frequency of occurrence of the sound (at the modelled, or another level) is also a factor when

considering the overall potential effect. Infrequent occurrences generating higher noise levels than the scenario we have modelled are certainty possible. You can see that in the sound power discussion in section 3.1 of our report.

We have updated the model to also take into account the most recent tower height changes, and looked at the receiver height issues you have raised. Outcomes as follows:

- 24 Oregon Heights – this property is totally shielded by the terrain at both receiver heights.
- 17 Oregon Heights – this property has less shielding from the terrain. But this property does not appear to be two storey at the northern side (closest to the ride); the second storey is beneath the main house on the southern side. The house does have some north facing clerestory windows (at a second story level). For this property the tower height changes are relevant. As discussed the overall outcome from the updated analysis is that the zones where speed control of the ride may be advisable increase to be within 150 metres of the final corner (increased from 100 metres), and some control in the vicinity of Tower D (refer figure 1.2 of our report) may also be appropriate depending on the actual tower / track configuration in this area.

Apologies for the long email. Happy to discuss once you've had a chance to consider.

Kind regards,

Gary

Gary Walton

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