Subject: Navcon Project No. 173729b [Rev B], Municipality of North Cowichan
Vancouver Island Motorsport Circuit (VIMC) Noise Studies Peer Review

Reference Documents:

3. BeSB GMBH Berlin, Report No. 61545.1G01-17, "Vancouver Island Circuit, construction phase 1 – noise study, sound impact assessment and measurement report", dated September, 26, 2017

Dear David,

As you requested, we have reviewed the Vancouver Island Motorsport Circuit (VIMC) noise reports prepared by RWDI Wakefield Acoustics (Wakefield) and BeSB GMBH Berlin (BeSB). We have talked with both firms and reviewed their test data files, test logs, noise calculations, etc.

Both RWDI Wakefield Acoustics and BeSB Berlin concluded that VIMC is operating in conformance with the applicable noise regulation and that VIMC does not represent a significant noise impact to the surrounding community. Navcon does not agree with their assessments. It is Navcon’s opinion that the VIMC operation represents a significant noise impact to the surrounding community. On the following pages we present a brief review of the project background and noise regulations and a detailed examination of the Wakefield and BeSB reports.

I will point out that Navcon is acting as an independent third-party consultant. We are not under contract to either VIMC or anyone who has ties to the residential community. Our review is objective and based purely on the reports and data provided by Wakefield and BeSB and public information which we found on the internet.
Background:

1. Residents in the communities surrounding the VIMC, including members of the Sahtlam Neighborhood Association (SNA) have been complaining about track related noise since its opening in April 2016.

2. RWDI Wakefield Acoustics was retained by SupErb Construction Ltd. to conduct a noise study of VIMC. They presented their findings in a report dated 26-Oct-2016 [ref. 1]. They prepared a second document summarizing their study 23-Mar-2017 [ref. 2].

Wakefield based their noise impact assessment upon two measurement surveys and the noise levels they recorded at 2 residential locations. One survey was conducted during a track day and one survey was conducted during a non-track day. Wakefield concluded that the residential noise levels they measured during the track day survey were below the 60 dBA noise level limit for continuous noise sources and the 80 dBA noise limit for non-continuous noise sources as specified in CVRD Bylaw No. 3723. In their 26-Oct-2016 report [ref. 1] they stated, “Track noise was audible at the two residential monitoring sites and may cause annoyance to some individuals”.

3. BeSB Berlin was retained by GAIN Group, Vancouver Island to conduct a noise study of VIMC. They presented their findings in a report dated 26-Sep-2017 [ref. 3].

BeSB created an acoustical model of VIMC and the surrounding areas and used the model to make noise level predictions at 17 community locations. They then compared the predicted levels with the noise limits specified in CVRD Bylaw No. 3723 Section 6.1.3. BeSB concluded, “even the strongest track operation on a busy member track day will not exceed 60 dBA for $L_{Aeq,op}$ at any location in the neighborhood” and “furthermore the results of maximum sound levels $L_{A,max}$ according to Table 6-4 do not exceed the limit of 80 dBA for non-continuous noise”. They also stated, “in more quiet areas further away from the highway, especially on a on a busy member track day the motorsport noise will be significantly perceptible”. BeSB recommended that a noise monitoring system be installed to control and monitor noise from VIMC during its daily operation.
Definition of Noise & Noise Impact:

1. The World Health Organization (WHO) defines noise as unwanted sound or set of sounds that cause annoyance or can have a health impact. Noise poses a risk to people’s health and quality of life because it can lead to physical and psychosocial effects.

2. Noise annoyance disrupts a person’s quality of life and can bring on negative emotions such as disappointment, anger, hate, etc. By definition, a nuisance is a person or thing who is annoying while annoyance is the feeling of being annoyed. Both can have the same meaning. WHO considers the annoyance caused by environmental noise a public health problem.

3. Noise impact can be judged on (1) the extent to which governmental regulations or guidelines may be exceeded, and (2) the extent to which it is estimated that people may be annoyed or otherwise adversely affected by the sound.

Governmental Regulations:

1. VIMC is located in the District of North Cowichan. The local noise regulation, Bylaw No. 2857 is “nuisance-based” and mandates:

   2. No person shall make nor allow to be made any noise that disturbs the quiet, peace, rest, enjoyment, comfort, or convenience of any person or persons in the neighborhood or vicinity, whether by any animal, vehicle, conveyance, vessel, machinery, equipment, device, or activity,

   3. (3) Using an engine or motor vehicle without a muffler or other device which would prevent excessive noise therefrom, or so out of repair, or equipped in such a way as to disturb the quiet, peace, rest, enjoyment, comfort, or convenience of any person or persons in the neighborhood or vicinity;

2. Since the North Cowichan Noise Bylaw No. 2857 is a “nuisance-based" bylaw and does not provide any noise level limits, both Wakefield and BeSB choose to base their noise impact assessments upon the noise level limits stated in Cowichan Valley Regional District (CVRD) Bylaw No. 3723 for “Continuous Sound" and for “Non-continuous Sound" which are defined as follows:
"Continuous Sound" means any noise or noises, other than Construction Noise, continuing for a period, or periods, totaling 3 minutes or more in any 15 minute period;

"Non-continuous Sound" means any noises or sounds other than Continuous Sound and Construction Noise;

The CVRD Bylaw No. 3723 noise level limits are set forth in Section 6.1.3 which reads:

6.1.3 in addition to the noises or sounds described in Sections 6.1.1 and 6.1.2

(a) any Continuous Sound that exceeds the following Sound Levels at the Point of Reception:

7:00 a.m.- 9:00 p.m. 60 dBA Sound Level Limit
9:00 p.m.- 7:00 a.m. 50 dBA Sound Level Limit

(b) any Non-Continuous Sound that exceeds the following Sound Levels at the Point of Reception:

7:00 a.m.- 9:00 p.m. 80 dBA Sound Level Limit
9:00 p.m.- 7:00 a.m. 65 dBA Sound Level Limit

CVRD Bylaw No. 3723 also has a “nuisance-based” component which is described in Section 5, General Regulations. Section 5.1.1 describes the nuisance component of the regulation, Section 5.1.2 references the noise level limits. Section 5.3 states that a person (or entity) can be in conformance with the CVRD noise level limits yet may still be in violation of the Bylaw.

5 CVRD Bylaw No. 3723 General Regulations

5.1 No person shall make or cause, or permit to be made or caused, any noise or sound which:

5.1.1 disturbs, or is liable to disturb, the quiet, peace, rest, enjoyment, comfort, or convenience of individuals or the public; or

5.1.2 exceeds the Sound Levels prescribed in this Bylaw.

5.2 No owner or occupier of real property shall allow the real property to be used so that noise or sound which emanates from the real property:
5.2.1 disturbs, or is liable to disturb the quiet, peace, rest, enjoyment, comfort, or convenience of individuals or the public; or

5.2.2 exceeds the Sound Levels prescribed in this Bylaw.

5.3 Despite compliance with Part 6, a person may be found in violation of Sections 5.1 or 5.2.

Wakefield Acoustics Noise Study [ref. 1 & 2]

Wakefield was retained by SupErb Construction Ltd. to conduct a noise study of the Vancouver Island Motorsport Circuit (VIMC) and its potential impact at neighboring residences. Their work included two noise monitoring surveys, data reduction, noise assessment, preparation of a test report [ref. 1] and preparation of a summary letter [ref. 2].

1. The first noise survey was conducted 28-Aug-2016 during a VIMC Track Day. Noise data was collected over a 4.5-hour period (10:30 am to 3 pm) at one track side location, one location next to the Cowichan Valley Highway and two residential locations.

2. The second noise survey was conducted 16-Sep-2016 during a Non-Track Day. Noise data was collected over 2-hour period (10:30 am to 12:30 pm) at two locations next to the Cowichan Valley Highway and at the same two residential locations monitored during the VIMC track day survey.

The following comments are based upon our review of the Wakefield report [ref. 1], the Wakefield summary letter [ref. 2], the project data exchange (data files, acoustic wave files and field test log) and discussions with the Wakefield engineer who conducted the noise surveys.

► Only one Wakefield engineer was present during each noise survey which can be problematic in regard to documenting and understanding what was going on at the track and the residential noise monitoring locations. Wakefield provided Navcon with their field notes from the 28-Aug-2016 Track Day survey but the notes were for the most part illegible. Navcon discussed the field notes with the Wakefield engineer who created the notes and he was also unable to read them. Wakefield was not able to provide their field notes from the Non-Track Day survey and said that the project folder had been lost or misplaced.

► Wakefield did not document the vehicle makes (e.g., Porsche, Audi, BMW, etc.), the vehicle models (e.g., GT3, Boxster, R8, M4, etc.), the number of cars on the track during each driving
session, the start and stop time for each driving session or the type of track operation (e.g., Circuit Taxi Experience, Driving Experience, Member Track Day or Busy Member Track Day). However, the Wakefield engineer who conducted the noise surveys said that to the best of his recollection, Porsche was conducting a "sales event" with potential customers during the Track Day survey. He also added that there was an autocross course setup in the VIMC parking lot and that the customers were switching between the VIMC track and autocross track throughout the Track Day survey. We do not know whether it is common practice for VIMC to run autocrosses in their parking lot during Track Day events.

To better understand the type of track operation which was going on during the Track Day survey, we created a graph using the 1-second $L_{eq}$ levels recorded by the Wakefield track side noise monitor between 11:00 am and 11:30 am (refer to **Navcon Figure 1**). The Wakefield monitor was positioned 15m (~50') south of the shoulder of the track between the start/finish line and Turn 1. With an open track ahead, the cars should be at full throttle / full load when passing the microphone. Wakefield used the data recorded during this time period (i.e., 11:00 am to 11:30 am) to assess the VIMC track noise impact at Sahtlam Rd. (Site 4) as presented in **Table 3** of their report [ref. 1]. As shown in **Navcon Figure 1** the maximum track side pass-by noise level during the 30-minute period was 92 dBA while most of the peaks ranged between 70 dBA and 85 dBA. Navcon has a database of pass-by noise levels for various street legal and race cars. Following are the pass-by noise levels for three street legal Porsche models under full engine load and measured at 15m (~50'). The VIMC Track Day pass-by noise levels were several decibels below these levels

- Porsche GT3: 99 dBA with the factory exhaust in Sports Mode
- Porsche Cayman: 96 dBA with the factory exhaust in Sports Mode
- Porsche Turbo S: 91 dBA with the factory exhaust (no Sports Mode)

The average lap time for the car with the highest pass-by noise levels was 115 seconds. The track calculated speed for a Porsche GT3RS is 83.2 seconds and during a discussion with a VIMC driving instructor we learned that the average Porsche Cayman S lap times are in the range 86 to 87 seconds. We also checked lap times on the web site, MYLAPS.com and confirmed that 86 to 90 seconds are common lap times during VIMC Track Day events. The cars which were on
track during the Track Day survey were running extremely slow lap times which explains why the Wakefield track side and the community L_{max} and L_{eq} noise levels were so low.

Based upon the track side pass-by noise levels and the vehicle speeds (refer \textbf{Navcon Figure 1}) it is Navcon's opinion that the Track Day operation was similar to a Circuit Taxi Experience which represents the lowest level of Track Day Operation.

The noise data recorded by Wakefield can be considered a "data point", however it is not representative of the noise impact experienced by the community during a Member Track Day or a Busy Member Track Day. Wakefield should have conducted the Track Day survey during a Busy Member Track Day or similar track event when the track noise impact would be at its highest level, not its lowest level.

\textbf{Table 2} of the Wakefield report [ref. 1] summarizes the levels recorded during the entire Track Day survey. They considered three noise metrics:

- \( L_{eq} \) (5 min) which is the equivalent continuous sound level calculated for consecutive 5-minute periods for the entire Track Day
- Overall \( L_{eq} \) which is the equivalent continuous sound level for the entire Track Day
- Highest \( L_{max} \) which is the highest noise level measured during the Track Day

In regard to the noise impact assessment, \textbf{Table 2} does not provide any useful information for the following reasons:

- As previously stated, the Track Day event was essentially a Circuit Taxi Experience and the track noise was at a minimum.
- Without a detailed log of the track activities (e.g., the types and number of cars on the track, the session start/end times, etc.) as well as a description of the sounds at the community locations, it is not possible to relate the track noise with the community noise impact.
- The \( L_{eq} \) (5 min) is not a measure called out in CVRD Bylaw No. 3723 and it is not a good indicator of community noise annoyance.
- The Overall \( L_{eq} \) is not a measure called out in CVRD Bylaw No. 3723 and it is not a good indicator of community noise annoyance.
- Highest $L_{\text{max}}$ levels at noise monitoring Sites 1 - 4 were recorded at different times and there is no description of the corresponding track and community noise events.

Table 3 of the Wakefield report [ref. 1] summarizes the noise measurements recorded at Sahtlam Rd. (Wakefield Measurement Location Site 4) during the Track Day survey. Of most interest is the fact that the Wakefield engineer who conducted the noise survey identified 53 track related noise events between 11:00 am and 11:30 am by listening to their audio recording. The Wakefield engineer indicated that each of the 53 events lasted roughly 10 seconds for a total time of 8 minutes, 50 seconds of the 30-minute measurement period. In other words, the track was clearly audible approximately 30% of the time between 11:00 am and 11:30 am. Referring to Navcon Figure 1, the peaks show that 31 cars or groups of cars passed the track side microphone between 11:00 am and 11:30 am. This means that the Sahtlam Rd. location was also impacted by 22 car related events from other locations on the track. This makes sense considering that there are seven locations on the track where the cars are likely to be at full throttle and since Sahtlam Rd. is elevated, the forest has less effect on the sound propagation. The community is not just impacted by the cars traveling down the front straight (i.e., from Turn 19 to Turn 1 to Turn 2), the community is also impacted from cars at other locations on the track.

We created a graph using the Wakefield statistical noise data recorded at the Sahtlam Rd. location during their Non-Track Day survey and superimposed the range of track related $L_{\text{max}}$ levels (i.e., 38.4 dBA to 59.9 dBA) they recorded during their Track Day survey (refer to Navcon Figure 2). The $L_{\text{max}}$, $L_{50}$, $L_{90}$ and $L_{\text{min}}$ are levels averaged over 5-minute periods. They are defined as follows:

- $L_{\text{max}}$ is the maximum noise level measured during the 5-minute period.
- $L_{50}$ is that noise level which was exceeded 50% of the time during the 5-minute period.
- $L_{90}$ is that level which was exceeded 90% of the time during the 5-minute period. $L_{90}$ is also that level which is considered to be the "ambient" noise level. Noise impacts are often assessed by comparing noise event levels with $L_{90}$ levels. It is a good metric for predicting annoyance and how communities may react to noise.
- $L_{\text{min}}$ is lowest noise level measured during the 5-minute period.
The graph clearly shows that the range of track related $L_{\text{max}}$ levels is 20 dBA to 30 dBA higher than the $L_{90}$ Levels (i.e., the community ambient noise level) which is why the Wakefield engineer could easily identify (i.e., hear) the 53 events in the audio recordings. As previously discussed, the Track Day survey was conducted during a low noise event (i.e., Circuit Taxi Experience). We anticipate the track related noise events (i.e., the $L_{\text{max}}$ levels) are even more noticeable during a Member Track Day or Busy Member Track day.

**Tables 4 & 5** of the Wakefield report [ref.1] summarize the Non-Track Day measurement data recorded over the entire survey period. The noise metrics include the Minimum and Maximum $L_{\text{eq}}$ (5 min), the Overall $L_{\text{eq}}$ and the Highest $L_{\text{max}}$ level. The data, as presented does not provide any additional useful information in regard to the VIMC noise impact assessment.

**Table 6** of the Wakefield report [ref.1] compares track related noise, aircraft noise and wood working tools noise with the noise limits specified in CVRD Bylaw No. 3723. Wakefield then concluded, “As shown in Table 6, track-related noise levels do not approach or exceed the noise limits in the Cowichan Noise Bylaw No. 3723.”

- As previously pointed out, Wakefield conducted their noise survey on a day when the VIMC activities were similar to a Circuit Taxi Experience; the track related noise was low due to the engine loads, vehicle speeds and slow lap times. The data they presented is merely a data point for this type of Track Day Operation. Wakefield should have conducted the survey on a “Busy Member Day” when the track related noise is higher.

- The comparison of aircraft noise and wood working tools noise with the noise limits really has no bearing on the VIMC noise impact assessment and should not be included in **Table 6**.

- The Wakefield engineer who setup their sound level meters and was onsite to acquire the test data indicated that they approached the project as though it were a traffic noise characterization study. He said that for traffic noise they typically record $L_{\text{eq}}$ (10 min) levels but because of the short track sessions he decided to record the Leq (5 min) levels. We believe that this was a mistake and that Wakefield should have aligned their noise measurements with the track sessions and that they should have kept a detailed log of the number of cars on the track, the vehicle types, vehicle speeds, etc.
In the Conclusion Section of their report [ref. 1], Wakefield stated, "Track noise was audible at the two residential monitoring sites and may cause annoyance to some individuals." Navcon listened to the Wakefield audio files and agrees with them that the track noise is clearly audible and likely to cause annoyance. The Wakefield recordings are similar to the YouTube videos posted by members of the Sahtlam Neighborhood Association and other residents affected by VIMC who are clearly annoyed with the track related noise.

Wakefield summarized their report [ref. 1] in a letter dated 23-Mar-2017 [ref. 2]. They stated, "Noise levels created by motorsport circuit operations on the track day never approached the limits contained in the Cowichan Noise Bylaw of 60 dBA for continuous noise and 80 dBA for non-continuous noise." We agree that the levels did not exceed the Bylaw limits but again, the Track Day was similar to a Circuit Taxi Experience which represents the lowest level of Track Day Operation and noise. Wakefield then talked about noise exposure:

- "The noise created by motorsport activities on the "track day" did not significantly influence the overall noise exposures experienced at the two residential sites."

- "Attended noise monitoring at the Mina Drive site revealed that overall noise exposures were dominated by Highway 18 traffic and that maximum noise levels, or Lmax, created by highway traffic (particularly logging trucks) substantially exceeded those created by motorsport circuit activities."

- "In conclusion it may be stated that, while noise from motorsport circuit activities was, at times, clearly audible in the community (particularly at the Sahtlam Road site), and the audibility and intrusiveness of these noises are enhanced by their character (tonality and variability), they do not dominate, not even significantly contribute to, the overall noise exposures of residents in the community."

Navcon does not agree with Wakefield's use of the term, noise exposure. Noise exposure is typically used in occupational settings when addressing high levels of noise which can result in temporary, long term or permanent hearing damage (e.g., tinnitus, hyperacusis, etc.) or other health related problems. This is not a noise exposure situation, this is a case of community noise annoyance.
In their conclusion Wakefield acknowledged that the track related noise is clearly *audible* in the community and in their own words, they stated that the noise is *intrusive*. They also wrote that the frequency content and temporal variations (i.e., fluctuations) of the sound enhances the *intrusiveness*. They countered this by stating that the track related noise does not “dominate” or even “significantly contribute” to the overall noise exposure of the residents. This is exactly why CVRD Bylaw No. 3723 has statutory nuisance provisions. Section 5 of the Bylaw, states that a person can be in compliance with the noise limits but may still be found in violation of the General Regulations.

We believe that Wakefield missed the point. They conducted their Track Day survey on a day when the VIMC was operating at a low level (i.e., Circuit Taxi Experience) and, using their own words, the noise was audible and intrusive in the community. The real question is whether or not the track related noise represents a legitimate nuisance to the community. Noise nuisance provisions provide an additional level of protection for communities. Section 5, states that a person can be in compliance with the noise limits but may still be found in violation of the General Regulations.

**BeSB GMBH Berlin Noise Study [ref. 3]**

BeSB was retained by the GAIN Group to conduct a detailed study of VIMC’s current operation (i.e., Phase 1). They developed an acoustical model which includes the three-dimensional ground terrain of the track and surrounding community, ground absorption, vegetation/forest absorption, and the vehicle noise emission. They used the model to make noise level predictions at selected community locations using the sound propagation method and algorithms according to an international standard, ISO 9613-2:1996. Finally, BeSB assessed the community noise impact by comparing their noise model predictions with noise limits specified in CVRD Bylaw No. 3723 Section 6.1.3.

The following comments are based upon our review of the BeSB report [ref. 3], the project data exchange (noise model and data files), emails and telecom with BeSB engineers.

- Navcon imported the BeSB acoustic model into the noise modeling software, SoundPLAN and verified the noise model input (ground terrain, the ground absorption areas, forest attenuation areas, VIMC building, etc.).
The accuracy of the BeSB noise model predictions and ultimately their noise assessment depends upon the track vehicle noise source characterizations (level, frequency content and directivity), the geometrical model (ground terrain, ground absorption, etc.), the noise model parameters (temperature, humidity, etc.) and the sound propagation algorithms (e.g., ISO 9613-2). In order to guarantee the accuracy of the noise level predictions the model must be validated. Validating a model is different from verifying the model input data. By definition, “validation” is the process of determining the degree to which a model is an accurate representation of the real world from the perspective of the intended use of the model. BeSB described their model validation procedure in Section 8 of the report [ref. 3].

**Step 1.** They conducted a noise survey during a VIMC Track Day and measured the pass-by sound pressure levels of a 1960’s Corvette at a microphone location on the front straight near the start/finish line (between Turns 19 & 1). At the same time, they recorded the sound pressure levels at three community locations. They then computed the measured difference levels ($\Delta L_{\text{measured}}$) by subtracting the sound pressure levels measured at the community locations from the measured track side sound pressure levels.

**Step 2.** They calculated the sound power emission level of the Corvette using the highest pass-by sound pressure levels measured at the trackside microphone location.

**Step 3.** They entered the Corvette sound power level from Step 2 into their noise model and applied the Porsche GT3RS speed calculation plan as shown in the Appendix of [ref. 3] and the corresponding track sound power distribution shown in Figure 4-1 of [ref. 3]. They used the model to back calculate the Corvette sound pressure level at the trackside location and to calculate the sound pressure levels at three community locations. They then computed the noise model predicted difference levels ($\Delta L_{\text{model}}$) by subtracting the sound pressure levels calculated at the community locations from the sound pressure levels calculated at the trackside location.

**Step 4.** They compared the measured difference levels ($\Delta L_{\text{measured}}$) with the noise model predicted difference levels ($\Delta L_{\text{model}}$), refer to Table 8-1 of [ref. 3] and noted that the model underpredicted the sound attenuation between the track and the community. They also compared the maximum sound pressure levels measured at the community
locations with the noise model predicted maximum sound pressure levels refer to **Table 8-2 of [ref. 3]** and noted that the model over predicted the sound pressure levels by 5 dBA to 11 dBA in the community. Based upon the test data recorded for the Corvette, BeSB concluded that the noise model was validated stating, "This means all results of the calculation model are on the so called safe side."

**Navcon does not consider the VIMC noise model to be validated.** BeSB claims the model is validated because it under estimated the sound attenuation and overestimated the community sound pressure levels for the Corvette test as described above. It is Navcon's experience and position that a calibrated noise model should predict the community noise levels to within 2 dBA to 3 dBA of the measured noise levels. An acoustic model which over predicts levels is not a validated model.

Navcon created a graphic showing the Corvette pass-by noise levels (refer to **Navcon Figure 3**). The maximum pass-by sound pressure level is 101.8 dBA which is equivalent to a sound power level of 133.23 dBA at 15m. The time shown between the sound pressure level peaks are the lap times. The Corvette lap times were 25 to 30 seconds slower than the speed plan for the GT3RS which is 83 seconds. BeSB explained that during the test, the Corvette was following a slower guidance vehicle (i.e., lead-follow laps). The Corvette would slow down before Turn 18, create a gap to the lead vehicle, accelerate past the trackside microphone, catch the lead vehicle and then drive at a slower pace around the rest of the track. With this driving pattern, it is understandable that the measured community noise levels were lower and that the sound attenuation levels / difference levels (i.e., $\Delta L_{\text{measured}}$) are high. BeSB also admitted that the $\Delta L_{\text{measured}}$ would be different if they had moved the trackside microphone to a different location.

The noise model predictions were based upon the Corvette pass-by noise levels on the front straight and then assumed that the Corvette was driving at a pace equal to the GT3RS for the entire track (i.e., the BeSB model used the GT3RS track sound power distribution shown in **Figure 4-1 of [ref. 3]**). Because the Corvette was running much slower lap times, the noise model over predicted the Corvette community noise levels and underpredicted the sound attenuation / difference levels (i.e., $\Delta L_{\text{model}}$).

- BeSB's model validation is based upon a very limited amount of data. They acquired data in five 30-minute spans (refer to **Tables 7-2 & 7-3 of ref. 3**). However, because of other noise
sources such as aircraft, they only used 5 to 6-minute spans of data (i.e., 2 to 3 laps for the Corvette) to compute the sound attenuation levels / difference levels (ΔL_measured).

- There is no reason to believe that the model would have overpredicted the community noise levels had BeSB used the Corvette’s actual speed profile and track sound power distribution. In fact, it is Navcon’s belief that the predicted levels would be much lower. The track equivalent relative sound power diagram presented in Figure 4-1 of the report [ref. 3] shows seven track sections where the engine is under full load with maximum sound emission. The Corvette was under full load between Turns 1 & 2 and considering the lap times, it is unlikely that the Corvette was under full engine load in the other sections of the track.

- There is also no reason to believe that the model will always over predict the community noise levels for other Track Day operations. Navcon does not agree with BeSB statement “all results of the calculation model are on the so called safe side”.

- BeSB based their noise model validation on measurements recorded at one trackside location and three community locations. The three community locations are approximately 300m, 900m and 1,800 m from the track. Considering the complexity of the noise source characterization, the ground topography, ground and forest affects, metrology affects, etc., Navcon does not believe that it is reasonable to claim the model is validated over the project area which, as defined in the BeSB model spans over 6 sq. km.

BeSB used the noise model to predict the track related sound pressure levels at seventeen community locations. They simulated three types of VIMC track operations, Driving Experience / Circuit Taxi Experience, Member Track Day and Busy Member Track Day. Navcon agrees that this is a reasonable way to describe the track operations. However, BeSB did not disclose the details behind their vehicle pass-by levels and frequency spectra; they simply stated that they used a representative sample from data they collected at racing circuits in Germany and elsewhere in Europe. They also had to estimate the number of vehicles that might be on the track during the track sessions. Since these noise model input parameters directly affect the predicted levels in the community, Navcon recommends that a safety margin of 2 to 3 dBA be added to the assessment. That is, 2 to 3 dBA should be added to the predicted levels or that the noise level limits be reduced by 2 to 3 dBA. This would result in a more conservative assessment and safe assessment.
BeSB summarized the noise model predictions for the three types of track operations in Table 1-1 of their report [ref. 3]. Table 1-1 is titled, "Sound Impact (during operation)". The table lists the track related $L_{Aeq,op}$ and $L_{Aeq,14h}$ levels and the Highway 18 $L_{Aeq,op}$ levels. The $L_{Aeq,op}$ is the equivalent continuous sound level during operation during track/driving sessions. $L_{Aeq,14h}$ is the equivalent continuous sound level averaged over a 14-hour period (7 am to 9 pm) including operation pauses and off-peak hours with no operation. The $L_{Aeq,14h}$ is ~2.4 dBA less than the $L_{Aeq,op}$ levels.

- The noise model predicted $L_{Aeq,op}$ levels as high as 56 dBA at four community locations including Sahtlam Rd. BeSB stated, "even the strongest track operation on a busy member tack day will not exceed 60 dBA $L_{Aeq,op}$ at any location in the neighborhood." In Section 9.1 of their report [ref. 3] BeSB cited the German standard "TA Lärm" which adds a +3 dBA penalty to motorsports sounds due to tonality such as engine sounds and tire squealing. We agree that this type penalty should be added to the VIMC track related noise. With the penalty, the predicted noise levels are within 1 dBA of the 60-dBA limit (i.e., $56\, \text{dBA} + 3\, \text{dBA} = 59\, \text{dBA}$). Considering that the noise model is not "validated" and that BeSB had to make some assumptions in regard to the model input parameters, it is our opinion that the predicted levels could exceed the 60-dBA limit at locations in the community.

- To avoid any confusion, we want to point out that the $L_{Aeq,14h}$ noise metric which is listed in Table 1-1 is not called out in CVRD Bylaw No. 3723 and that the $L_{Aeq,14h}$ level should not be compared with the 60-dBA continuous sound limit. In the body of the report, below Table 1-1 BeSB compared the track related $L_{Aeq,14h}$ levels with Highway 18 $L_{Aeq,14h}$ levels and concluded, "on a Busy Member Track Day the motorsports noise may be perceptible (depending on the influence of other ambient noise sources such as airplanes, road noise, nature, etc.) but well below the limit of $L_{Aeq,15\min} = 60\, \text{dBA}$." Comparing the track related and Highway 18 $L_{Aeq,14h}$ levels, the track related levels are higher than the Highway 18 levels at 14 of the 17 community locations listed in the table. The track related levels are as much as 23 dBA higher than the traffic levels and at the Sahtlam Rd. locations the track related levels are 10 dBA to 12 dBA higher than the Highway 18 levels. This is a much more than "perceptible" difference; a 10 dBA difference would be considered to be twice as loud and a 20 dBA difference would be considered to be four times as loud.
To visualize the noise impact at the Sahtlam Rd. location, we created a graphic which compares the predicted track related $L_{A_{eq,op}}$ levels and the Non-Track Day noise levels recorded by Wakefield on Sep. 16th, 2016. **Navcon Figure 4**, The predicted track related $L_{A_{eq,op}}$ levels range between 53 dBA and 56 dBA for a Busy Member Track Day. The measured Non-Track day the $L_{eq}$ levels ranged between 34.1 dBA and 53.1 dBA and the $L_{90}$ levels ranged between 30 dBA and 38 dBA. This graphic indicates that the track related noise during a Busy Member Track Day dominates the Sahtlam Rd. noise environment.

**Table 6-4** of the BeSB GMBH report [ref. 3] summarizes the predicted maximum sound impact peaks ($L_{A_{F_{max}}}$) during a Busy Member Track Day. The predicted maximum levels at the Sahtlam Rd. location range between 63 dBA and 64 dBA. To visualize the noise impact, we created a graphic which compares the predicted track related $L_{A_{F_{max}}}$ levels and the Non-Track Day noise levels recorded by Wakefield on Sep. 16th, 2016. Referring to **Navcon Figure 5**, the track related noise peaks during a Busy Member Track Day dominate the Sahtlam Rd. noise environment.

In **Section 10**, of their report [ref. 3] BeSB proposed that a noise monitoring system be installed to “control and document” VIMC’s daily operation”. They included a description of the system and proposed a trackside pass-by noise limit of 103.6 dBA measured at 21m which is 106.5 dBA at 15m. Navcon agrees that VIMC should install a noise monitoring system to control the trackside pass-by sound pressure levels but we disagree with the limit proposed by BeSB. It is not our role to propose noise limits or noise mitigation measures. However, we suggest that a comprehensive community noise monitoring survey be conducted and the survey be coordinated with members of the community. Reasonable trackside limits can then be established which hopefully will satisfy the needs of the community and VIMC.

Please feel free to contact Hans Forschner or me if you have any questions about our review.

Prepared by,
[Signature]
Jim Steedman, President
Navcon Engineering Network

Reviewed by,
[Signature]
Hans Forschner, Sr. Acoustic Specialist
Navcon Engineering Network
Wakefield Test Data - Track Day [28-Aug-2016, 11:00 AM to 11:30 AM]

- The red dashed line shows the highest pass-by noise level planned by VIMC [ref. BeSB GMBH report dated 26-Sep-2017]
- The arrows point out the maximum measured track side pass-by levels.
- The average lap time was ~115 seconds.
- All levels are with slow meter response.

- Porsche Pass-By Noise Levels at Full Engine Load [ref. Navcon database]
- Porsche GT3 Pass-By Noise Level - 99 dBA
- Porsche Cayman Pass-By Noise Level - 96 dBA
- Porsche Turbo S Pass-By Noise Level - 91 dBA

Note: The highest measured level was 92.6 dBA which is ~7 dBA lower than a GT3. BeSB has proposed a maximum level of 106.5 dBA.
Navcon Figure 2 Wakefield Non-Track Day – Noise Data Collected at Sahtlam Rd. (Site 4)

The track related Lmax levels measured by Wakefield on 28-Aug-2016 ranged between 38.4 dBA and 59.9 dBA. The track related Lmax Levels are well above the L90 Levels and are clearly audible.

The red line is the L90 Level and considered to be the Sahtlam Rd. Ambient Noise Level. The range of track related noise events are well above the Ambient Noise Level and clearly audible.

Note: The Wakefield data was collected on a day when VIMC was operating a low noise event (i.e., Circuit Taxi Experience).
Navcon Figure 3. Corvette Pass-By Noise Levels Used to Validate the Acoustical Model

Note: The slow Corvette lap times and corresponding low engine loads resulted in lower community noise levels.

Navcon Project No. 173729b, VIMC – Wakefield & BeSB GMBH Noise Studies Peer Review
Navcon Figure 4 Sahtlam Rd. BeSB Noise Model Predictions (L_{Aeq,op}) vs. Wakefield Non-Track Day Levels

The noise model predicted the track related L_{Aeq,op} levels at Sahtlam Rd. to be between 53 dBA and 56 dBA. The track L_{Aeq,op} levels are well above the Non-Track Day L_{90} levels and also higher than the Non-Track Day Leq levels. The Track Day noise is clearly audible.

The red line is the L_{90} level and considered to be the Sahtlam Rd. Ambient Noise Level. The predicted track related L_{Aeq,op} levels are well above the Ambient Noise Level and clearly audible.

Note: The predicted VIMC track related noise (L_{Aeq,op}) is higher than the current ambient noise level at the Sahtlam Rd. location.
The noise model predicted the track related LAFmax levels at Sahtlam Rd. to be between 63 dBA and 64 dBA. These peak levels will be clearly audible at the Sahtlam Rd. Locations.

The red line is the L90 level and considered to be the Sahtlam Rd. Ambient Noise Level. The predicted track related LAFmax levels are well above the Ambient Noise Level and clearly audible.

Note: The predicted VIMC track related noise (LAFmax) is higher than the current ambient noise level at the Sahtlam Rd. location.