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April 12, 2022

File: 2407-22A-R02

University Neighbourhoods Association
202-5923 Berton Avenue
Vancouver BC V6S 0B3

Attention: Wegland Sit

Dear Wegland,

Re: Wesbrook Temporary Basketball Court
Noise Assessment

It is proposed that a temporary outdoor basketball court will be located near Wesbrook Community Centre between Berton Avenue and Webber Lane in Vancouver near the University of British Columbia. As part of this proposal, BKL has been engaged to conduct a noise assessment of the proposed basketball court. Noise measurements at an existing outdoor basketball court were conducted and used to inform a 3-D noise model for the proposed court. This document outlines the findings of our assessment. A glossary of acoustic terms are attached.

Scope of Assessment

The University Neighbourhoods Association (UNA) request a noise study be completed via email on March 22, 2022. The scope of the requested assessment was as follows:

The study will measure impact noises resulted by:

1. *ball bouncing*
2. *players noise*
3. *ball striking the backboard*
4. *ball striking the hoop.*

Acoustic consultant will conduct noise measurement and then process noise measurement into noise model of the proposed basketball site. Noise model will use GIS data from UBC Campus Planning to simulate the surrounding buildings and terrain. This model should include:

1. *The proposed basketball court location*
2. *Existing buildings information*
3. *Proposed building in Lot 6 information (good to have but not absolutely necessary)*

Based on the noise model, the noise model should accurately predict noise level from basketball court usage and then compared to the UNA noise bylaw.

Reporting will provide detail of the methodology and result of the noise impact assessment.

While we are not able to reliably anticipate the basketball court usage, our assessment considers the required noise sources, typical usage and predicts the noise level at the requested building using standard acoustic modelling methodologies.

Project Description

The proposed outdoor basketball court location is northeast of the existing volleyball courts in the Wesbrook Park area. Sports fields, volleyball courts and a soccer field, are located to the west and northwest of the proposed court respectively. The closest noise sensitive buildings are low-rise multi-family residential buildings which are located to the east and southwest of the court. To the southeast of the proposed court is undeveloped land which is proposed to be developed into multi-family residential in the future. The proposed court (shown in red), adjacent facilities and closest noise sensitive receptors are shown in Figure 1.

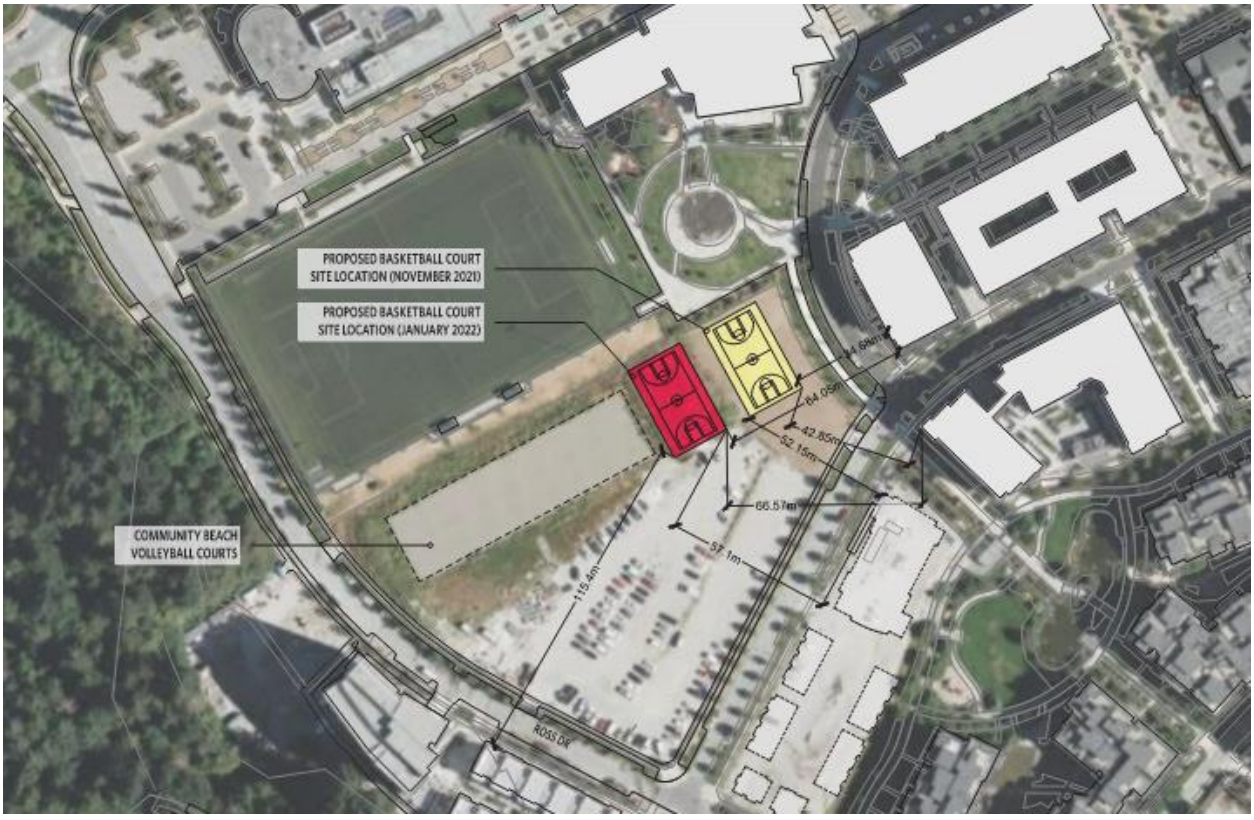


Figure 1: Proposed Court, Adjacent Facilities and Closest Noise Sensitive Receptors

The proposed outdoor court is a standard size basketball court with one hoop at each end of the court. There are no other facilities associated with court. The expected activities at the court will include those typical of a community outdoor court; a mix of individual use, small group use (shooting and bouncing of ball) and basketball games (can be either half court or full court games). There is

typically no management of the use of outdoor courts so the actual use will depend on the individual users and could involve any combination of the activities listed above (e.g., individual skills at one hoop, half court game at the other hoop). The noise from the court will be associated with basketball bouncing (ball contact with the court surface), ball impact with the hoop and backboard and verbal communication from the users of the court. There will also be periods of time when the court is not in use.

Criteria

The proposed court and noise sensitive receptors are both located within the University of British Columbia area. Noise within the area is governed by the University Neighbourhoods Associated (UNA) Noise Control Bylaw (issued 2008).

The noise bylaw states that that no person shall cause continuous sound (defined as a sound that occurs for more than three minutes in a 15 minute period) of which:

> Daytime (Weekdays: 7am to 10pm, Weekend & Holidays: 10am to 10pm) exceeds 55 dBA at a point of reception
> Nighttime (all other times) exceeds 45 dBA at a point of reception.

The bylaw states that the dBA levels are slow response levels. The Point of Reception can be represented as the property line of the receptor. It also states that no person shall cause non-continuous sound which disturbs the quiet of any person. As the bylaw states that the noise criteria can not be exceeded and that dBA levels are slow response, we have assumed that the Lmax(slow) is the appropriate noise metric to consider for the bylaw assessment.

Noise Measurements

Outdoor Basketball Court Activities

To assist with developing the noise model of the proposed court, BKL conducted noise measurements at an existing outdoor basketball court located near Totem Park Residences on Thunderbird Blvd. The measurements were taken on March 25, 2022 between 10:15am and 11:45am. The measurements captured the following activities:

- Half court basketball games with six players;
- Activity at both ends of the court – half court game and individual training; and
- Individual activities including bouncing basketball and basketball impacts with hoop and backboard.

While the Lmax (slow) metric is relevant for the bylaw assessment, we have reported the Leq and Lmax (slow and fast response) for completeness. During the measurements, there were other activities in the area which contributed to the noise environment including aircraft passbys and vehicle passbys. The measurements are summarised in Table 1 below.

Table 1: Summary of Basketball Court Measurements

Activity	Distance	Measured Level		
		Leq	Lmax (slow)	Lmax (fast)
Bouncing ball	3m	67 dBA	70 dBA	75 dBA
	5m	61 dBA	64 dBA	67 dBA
Shooting ball (impact with backboard and hoop)	3m	60 dBA	68 dBA	74 dBA
	5m	57 dBA	62 dBA	69 dBA
Half court game 3 on 3 (six player total)	6.5 m from the west edge of court	58 dBA	70 dBA	71 dBA
	Centre court	59 dBA	66 dBA	72 dBA
	1m from edge of court	61 dBA*	Between 61 and 77 dBA	Between 69 and 84 dBA
Both ends of court in use: Half court game 3 on 3 (six player total) at north end and individual training at south end	Centre court	61 dBA	68 dBA	76 dBA

* average based on 6 measurements around perimeter of the court

Ambient Noise Levels

On March 25, 2022, noise measurements of the ambient noise levels were also taken, both near the existing court and near the sensitive receptors at the proposed site. Location 1, near the existing court, was selected to be representative of the ambient environment but away from the activities at the tennis and basketball courts. Location 2 was selected to be representative of the buildings near the proposed basketball court.. The measurement results are provided in Table 2. The monitoring locations are shown in Figure 2.

Table 2: Summary of Ambient Nosie Level Measurements

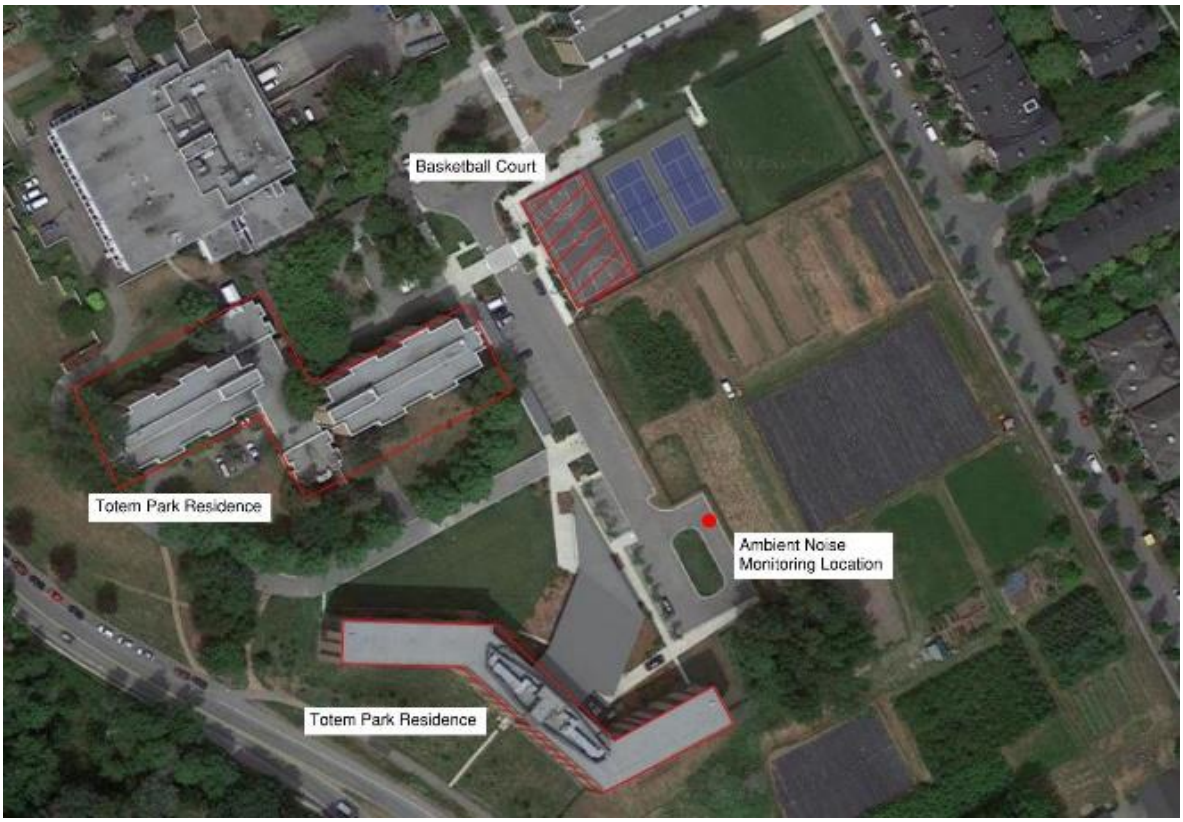
Site	Description	Time	Measurement		
			L90	Leq	Lmax
Location 1: Near Totem Courts	The monitoring was conducted at an open space which was 65 m away from the basketball court. Two residential buildings were located 50 m to the south and 70 m to the west of the monitoring location. The microphone was set up at the height of 1.5 m above ground. During the monitoring period, recurringr noise from aircraft, occasionally traffic movements, and distant maintenance works were observed near the monitoring location.	11:30 – 11:40	42 dBA	49 dBA	64 dBA (fast) 63 dBA (slow)
Location 2: Wesbrook Community	The monitoring was conducted at an open space on Webber Lane 23 m across from Webber House. Another residential building was located 48 m to	11:59 – 12:14	46 dBA	55 dBA	71 dBA (fast) 69 dBA (slow)

Site	Description	Time	Measurement		
			L90	Leq	Lmax
	the south of the monitoring location. The microphone was set up at the height of 1.5 m above ground. During monitoring period, recurring noise from aircraft, occasionally traffic movements, and children playing were observed. During the measurement, there were garbage loading sounds from a truck but these were excluded from the ambient measurement.				

Figure 2: Ambient Monitoring Locations

Location 1:	Location 2:
	

Location 1:



Location 2:

Noise Model

A 3-D noise model was developed using noise modelling Cadna/A software. The model implements noise prediction standard ISO9613-2 and considers the heights of the sources and receptors, reflective surfaces, octave band level for each noise source and ground type. The model setup details are provided in Table 3 below.

Table 3: Model Setup and Data Inputs Summary

Parameter	Value
Calculation Standard	ISO 9613-2:1996
Ground Absorption	G = 0 (hard ground) for hard surfaces like concrete and basketball court G = 1 (soft ground) for park area
Reflection Order	2
Building Reflection Loss	1 dB
Building heights and outlines	Building outlines and heights mostly provided by UNA, where data was not available building heights were estimated from aerial images and photos taken on site.
Ground elevation contours	City of Vancouver 1m contour lines

For the model, we included the three most significant noise sources:

- Bouncing of ball;
- Sound of hoop when ball impacts (measurement included backboard and hoop impacts); and
- Player communication.

We used the results of the noise measurements taken at the site to estimate the sound power level (Lw) for each noise source and to calibrate the noise model. Given that there were other noise generating activities in the area, the noise measurements of the individual activities were typically the most reliable to develop a sound power level for the different activities. The average levels predicted by the model for a basketball game were within 1 dB of the levels measured during the 3 on 3 game on March 25, 2022.

For the assessment, we modelled a representative worst-case scenario with a half court game of three on three at both ends of the court (total of 12 players using the court). The Lmax (slow) levels were predicted for every floor of the building that are adjacent to the proposed court, including the proposed buildings to the east of the court that are not yet built.

The noise sources used in the model are summarized in Table 4 below.

Table 4: Nosie Source Details

Source	Type	Lw (dBA)	Height	Description
Bouncing of ball	Area source	85	0.25 m	Noise from ball impacting the ground. As per our measurements, we have assumed the Lmax (slow) level is 4 dBA higher than the average level.
Shooting of ball	Point source	78	3 m	Noise from impact of ball against the backboard and the hoop. As per our measurements, we have assumed the Lmax (slow) level is 8 dBA higher than the average level.
Voice from players	Area source	75	1.5 m	We have assumed that all players will communicate with a raised voice and that one person will be speaking at all times. We have assumed the Lmax (slow) level is 8 dBA higher than the average level which is consistent with a typical “loud” vocal effort level.

Discussion

The model predicted the noise levels for all buildings surrounding the site at every floor. The highest predicted Lmax (slow) level on each facade is shown in Figure 3.

Figure 3: Predict Noise Levels Lmax (slow) - dBA

The highest predicted Lmax (slow) level is 45 dBA at 3388 Webber Lane and the proposed dwellings on Birney Ave. This occurs for most floors for the facades facing the courts as shown Figure 4. The predicted noise levels are all below the 55 dBA daytime criteria but some building exposure levels are equal to the night-time criteria of 45 dBA.

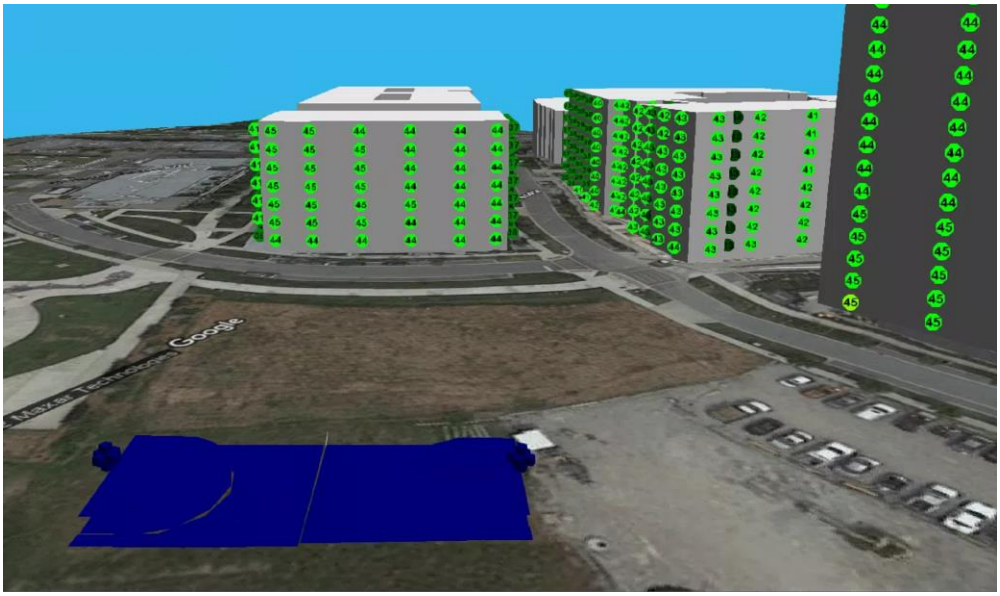


Figure 4: Predicted Facade Noise Level Lmax (slow) - dBA

Some noise sources are considered to be more annoying to humans due to their character (e.g. impulsive or tonal noise sources). It is possible that the noise sources associated with the courts could be considered impulsive and therefore may be more annoying to receivers. The UNA bylaw does not state any correction should be applied for sources which may be considered to be more annoying. However, for reference, ANSI S12.9-2005/Part 4 technical standard *Quantities and Procedures for the Description and measurement of Environmental Sound – Part 4: Noise Assessment and Prediction of Long-Term Community Response* states that a penalty of 5 dB can be added to account for the increased annoyance of a regular impulsive noise source. While this is not required by the bylaw, even if a 5 dB penalty was applied, the noise levels would be below the 55 dBA daytime criteria, however, it would exceed the nighttime criteria at a number of receptors.

While the bylaw specifies consideration of the slow response level, human response to impulsive sound is closer related to fast response levels. For completeness, we also reviewed the expected Lmax (fast) levels. Our measurements indicated that the Lmax (fast) level for basketball activities was typically between 5 and 8 dBA higher than the Lmax (slow) level. Therefore, the Lmax (fast) level at the closest receptor building could be up to 53 dBA Lmax (fast). We note that this level is below the 71 dBA Lmax (fast) level that was recorded during the ambient measurement taken at Location 2.

There is the potential for other noise sources such as conversation if there are spectators seated around the courts. To minimize the potential impacts, any seating should be faced away from the closest residential buildings.

Summary

BKL conducted noise measurements of basketball activities at Totem Courts to assist with developing a noise model for the proposal outdoor court to be located near the Wesbrook Community Centre. The noise model considered player communication, ball bouncing and shooting sound sources. The model indicates that the highest expected Lmax(slow) level would be 45 dBA. The typical noise level from basketball activities is not expected to exceed the daytime criteria at anytime but may exceed the nighttime criteria at some receptors.

We trust this information is sufficient for your purposes. Please let us know if you have any questions.

Sincerely,

BKL Consultants Ltd.
per:

Brigette Martin P. Eng.
Acoustical Consultant
martin@bkl.ca
Enclosures: Glossary

Glossary

A-weighting – A standardized filter used to alter the sensitivity of a sound level meter with respect to frequency so that the instrument is less sensitive at low and high frequencies where the human ear is less sensitive. Also written as dBA.

ambient/existing level – The pre-project noise or vibration levels.

decibel – The standard unit of measurement for sound pressure and sound power levels. It is the unit of level that denotes the ratio between two quantities that are proportional to pressure or power. The decibel is 10 times the logarithm of this ratio. The reference pressure used for airborne sound is 20 µPa, while the typical reference pressure used for underwater sound is 1 µPa. Also written as dB.

equivalent sound level - The steady level that would contain the same amount of energy as the actual time-varying level. Although it is, in a sense, an “average,” it is strongly influenced by the loudest events because they contain the majority of the energy.

maximum sound level – The highest exponential time-averaged sound level, in decibels, that occurs during a stated time period. The standardized time periods are 1 second for "slow" and 0.125 seconds for "fast" exponential weightings

octave bands – A standardized set of bands making up a frequency spectrum. The centre frequency of each octave band is twice that of the lower band frequency

receiver – A noise-sensitive stationary position at which noise levels are received.

sound – The fluctuating motion of air or other elastic medium which can produce the sensation of sound when incident upon the ear

sound power – The total sound energy radiated by a source per unit time

time response - Used to describe an exponential weighting applied to a signal to assist with observing the variation in sound pressure level or to better correlate with human perception of loudness. The standard time periods are 1 second for “slow” and 0.125 second for “fast” exponential weightings