Appendix F.2 Arup Study, Potential Echo Effects

Harvard-Westlake School

Harvard-Westlake Upper School Parking Improvement Plan

Sound Propagation Analysis

ISSUE

27 AUGUST 2013

ARUP

1 Executive summary

Sirius Environmental asked Arup to measure and analyse echoes associated with local topography and buildings around the proposed development site for the Harvard-Westlake Upper school Parking Improvement Plan, at surrounding noise sensitive receivers.

A sound propagation analysis (see Appendix) was conducted on August 12, 2013 to identify potential echoing effects associated with local topography around the proposed development site.

Eight loudspeakers in a hemispherical configuration (test noise source) were connected to an electronic noise generator capable of producing a maximum 104 dBA sound level at a distance of 10 feet from the face of the loudspeakers. The loudspeakers were set up in a hemispherical arrangement to characterize potential reflections from topography and structures. The hemispherical configuration of the sound source provided sound transmission in all directions that would allow reflected sound waves, if present, to be detected at the receiver locations. The study included 14 receiver locations around the Development Site, a representative locations east and west of Coldwater Canyon Avenue.

The sound transmission tests and analysis show there are no significant sound reflections (defined as being within 10dB of the direct sound), from local topography or neighbouring buildings at the surrounding receptor locations.

Airborne noise measurements were conducted as part of the site survey to characterize the minimum sound attenuation between the proposed development site and sensitive receptor locations neighbouring the site. The results are also documented in the Appendix.

Appendix

Sound Transmission Analysis

Overview

Date: August 12, 2013 between 10:00am and 5:00pm

Equipment: Bruel & Kjaer Hand Held Analyzer Type 2250JBL EON 15 loudspeakers (x 8)Tascam DR-40 Linear PCM recorder (digital playback)

Personnel: Terence Caulkins, Arup

George Kourtis, Arup subconsultant

Measurements:

- Measurements were conducted at 10 feet from a source generating pink noise and at fourteen receptor locations to assess the minimum sound attenuation between the proposed Harvard Westlake parking structure site and neighbouring receptor locations. Measurement locations are shown in Appendix – Measurement locations.
- The sound attenuation between the source and the noise sensitive receptors is presented in Appendix Measurement results – sound attenuation. The table of attenuations was established using the L_{eq} metric (the Equivalent Continuous Sound Level).
- Impulse response measurements were conducted at the fourteen receptor locations to detect the presence of potentially disturbing echoes created as a result of sound emitted from the source location reflecting off of neighbouring topographical structures such as hills, canyons or buildings. Results of this assessment are presented in Appendix Measurement results – sound reflection analysis.
- The calibration of the sound level meters and microphones was checked prior to the start and at the end of each survey, with no significant drift in level observed.

Measurement Locations

Location	Description
Source	Location of hemispherical source array, west of Coldwater Canyon Ave at the proposed site for the Harvard Westlake parking structure.
P1	Receptor location at southern boundary of Harvard Westlake property, west of Coldwater Canyon avenue.
P2	Receptor location at south side of Hacienda Dr near intersection with Coldwater Canyon Ave.
P3	Receptor location on right of way in front of 3663 Potosi Ave.
P4	Receptor location on north side of Avenida del Sol at intersection with Coldwater Canyon Ave.
P5	Receptor location at top of stairs above security kiosk on Harvard Westlake Driveway.
P6	Receptor location at southeast corner of Coldwater Canyon Ave. and Harvard Westlake Driveway.
P7	Receptor location north of 3900 Avenida del Sol.
P8	Receptor location south of 3788 Alta Mesa Dr.
P9	Receptor location at southern termination of Galewood St.
P10	Receptor location on Van Noord Ave. near intersection with Coldwater Canyon Ave.
P11	Receptor location at Northwest boundary of Harvard Westlake property, southeast of 12949 Blairwood Dr.
P12	Receptor location on right of way of Blairwood Dr, northwest of 12951 Blairwood Dr.
P13	Receptor location at western boundary of Harvard Westlake property, east of 12952 Blairwood Dr.
P14	Receptor location on north side of Halkirk St, east of intersection with Coldwater Canyon Ave.

Map source: Google

Neighbouring receptor locations measured around the proposed Harvard Westlake parking structure site, selected as representative of exposed noise sensitive receivers.

Location of hemispherical loudspeaker array (test noise source), west of Coldwater Canyon Ave at the site of the future development.

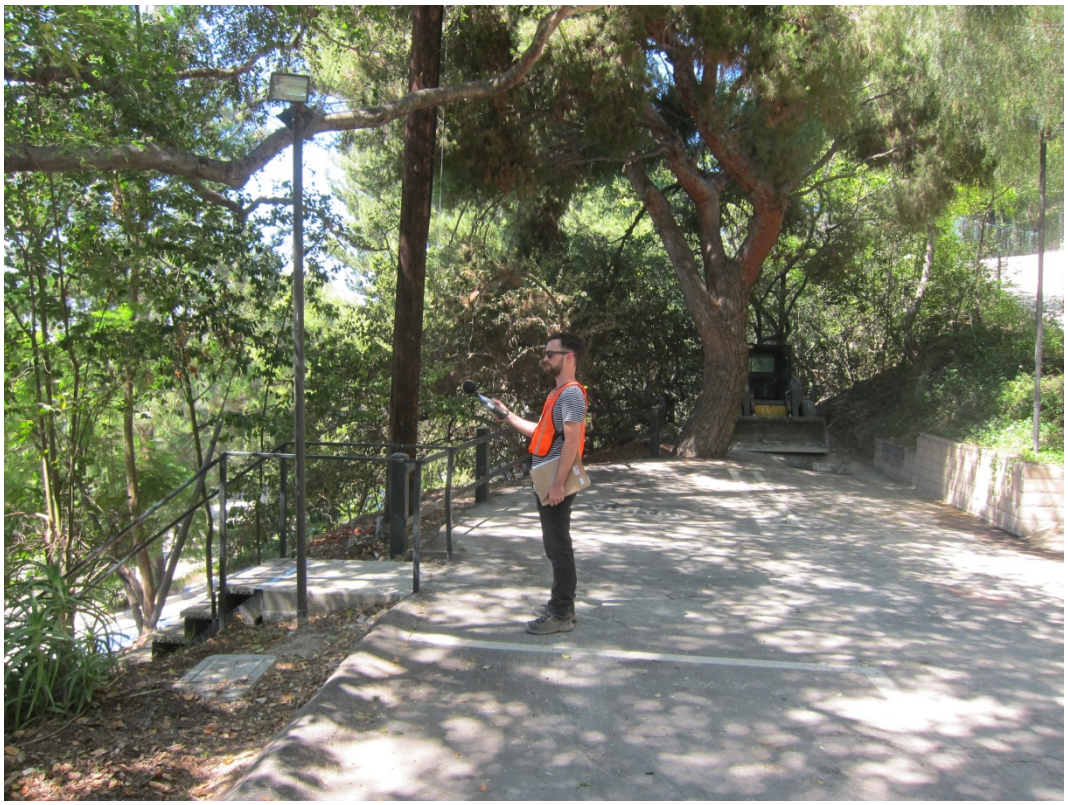
Enlarged view of hemispherical loudspeaker array.

Location P1: Near southern boundary of Harvard Westlake property, west of Coldwater Canyon avenue.

Location P2: South side of Hacienda Dr near intersection with Coldwater Canyon Ave.

Location P3: On right of way in front of 3663 Potosi Ave.

Location P4: On north side of Avenida del Sol at intersection with Coldwater Canyon Ave.



Location P5: At top of stairs above security kiosk on Harvard Westlake Driveway.

Location P6: At southeast corner of Coldwater Canyon Ave and Harvard Westlake Driveway.

Location P7: North of 3900 Avenida del Sol.

Location P8: South of 3788 Alta Mesa Dr.

Location P9:At southern termination of Galewood St.

Location P10: On Van Noord Ave. near intersection with Coldwater Canyon Ave.

Location P11: At northwest boundary of Harvard Westlake property, southeast of 12949 Blairwood Dr.

Location P12: On right of way of Blairwood Dr, northwest of 12951 Blairwood Dr.

Location P13: At western boundary of Harvard Westlake property, east of 12952 Blairwood Dr.

Location P14: On north side of Halkirk St, east of intersection with Coldwater Canyon Ave.

Measurement Results

Sound attenuation

Octave band sound level measurements were conducted at 10ft from the source location on the proposed Harvard Westlake parking structure site and at the fourteen receptor locations with the hemispherical sound source playing continuous pink noise. The attenuation of level between the site location and the receptor locations was derived by subtraction of the Leq level at receptor locations from the source Leq level. At certain receptor locations the ambient noise from Coldwater Canyon road met or exceeded the source level for specific octave bands – for these locations the attenuation from the source to the receptor could be greater than the (minimum) attenuation presented in Table 1 below:

Receptor Location	Minimum attenuation per octave band (in dB)								
	Octave Band Centre Frequency (Hz)								
	31.5	63	125	250	500	1k	2k	4k	8k
P1	28.4	34.1	44.2	45.7	49.0	41.0	46.2	47.0	50.6
P2	28.1	35.9	38.2	34.4	45.7	30.2	44.7	50.3	60.4
P3	32.3	42.7	45.1	41.5	41.3	33.9	47.4	53.3	66.6
P4	24.3	43.1	35.6	34.0	40.9	26.1	41.6	48.3	55.8
P5	23.3	38.4	35.7	36.4	42.8	33.0	41.5	46.9	56.2
P6	22.7	27.9	30.5	28.5	36.1	21.3	32.3	37.6	46.6
P7	27.7	40.5	37.4	37.0	44.6	32.1	43.8	47.4	58.3
P8	33.5	39.8	41.8	38.1	47.1	35.0	46.5	50.3	62.9
P9	27.2	37.6	38.8	42.1	47.4	33.6	44.5	48.8	55.8
P10	32.1	47.7	46.6	42.7	42.1	37.4	46.1	52.4	59.3
P11	26.0	32.0	31.7	22.3	31.6	30.0	33.5	35.1	42.8
P12	32.2	45.7	44.9	47.7	54.7	46.6	56.4	56.3	63.5
P13	26.9	36.5	36.5	32.7	32.6	27.9	38.6	40.9	54.0

Receptor Location	Minimum attenuation per octave band (in dB)								
	Octave Band Centre Frequency (Hz)								
	31.5	63	125	250	500	1k	2k	4k	8k
P14	24.5	42.4	39.5	36.5	45.2	32.1	41.0	45.8	51.3

Table 1: Minimum attenuation between proposed Harvard Westlake parking structure site and neighbouring receptor locations based on measured pink noise data.

Sound reflection analysis

Impulse responses were derived at each receptor location using exponentially swept sine test signals. These impulse responses were analysed to determine whether or not significant reflections could be detected at any of the receptor locations. For the purposes of this report, a significant reflection is defined as an isolated reflection arriving at least 50ms after the direct sound (due to the precedence effect, signals that arrive less than 50ms after the original sound, are not heard as a second sound, but as one sound) and with a level greater than 10dB below the direct sound. The following table provides the level of the most salient reflections measured at each receptor location:

Location	Arrival Time of most salient reflection after direct sound	Level of most salient reflection relative to the direct sound
P1	400ms	-12dB
P2	235ms	-21dB
P3	360ms	-16dB
P5	70ms	-11dB
P6	76ms	-11dB
P7	359ms	-19dB
P8	111ms	-17dB
P9	372ms	-22dB
P11	86ms	-28dB

Location	Arrival Time of most salient reflection after direct sound	Level of most salient reflection relative to the direct sound
P13	91ms	-23dB

Table 2: Arrival time and level of most salient reflections measured at receptor locations around proposed development site.

It is concluded that there are no significant reflections occurring due to the local topography at receptor locations P1, P2, P3, P5, P6, P7, P8, P9, P11 and P13.

It was impossible to measure impulse responses at locations P4, P10, P12 and P14 due to increased distance, large scale screening between source and receptor and ambient noise caused by steady traffic on Coldwater Canyon Ave. However, for these reasons no issues are anticipated due to isolated reflections at or around these locations.