APPENDIX D

Outdoor Event Noise Emission Prediction Model Refinements and Parameter Assumptions

DRAFT
Bonita Vista High School – Field Improvements
Outdoor Event Noise Emission Prediction Model Refinements and Parameter Assumptions

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1 SUMMARY

The prediction results using the Datakustik "CadnaA" software program suggest that a short (4'-tall) solid barrier (or material upgrade to a chain-link fence or guard-rail be installed atop the retaining wall that forms the back of the visitor bleachers—or be incorporated as a bleacher feature. In other words, in effect the retaining wall top edge—as a sound-occluding element—would increase in height by a minimum of four feet. Please see Figure 1, which highlights the location of this proposed wall/fence upgrade in "Detail A". This feature is helpful in reducing noise emanating from the seated crowd on the bleachers.

Other modeling notes are as follows:

- The model includes topography (rendered as terrain contours) in the vicinity of the eastern property line, using the site grading plans as guidance, so that the proposed features such as the mound/slope northeast of the renovated athletic are included.
- There are retaining walls in the model, but they are no greater than five feet in height above the base grade (thus, and consistent with the project plans, they merely hold back slope and present little or no above-ground "wall" or other obstruction that affects sound propagation).
- Sound power levels for the point sources (PA speakers) and area sources (occupied bleacher seating, marching band participants) are set at new levels that may be different from those currently shown in the EIR noise section event scenario descriptions; but, they are still grounded by the Dudek-performed measurements in June 2017 and citable research studies. However, any further noise reduction opportunities are limited based on the proposed project parameters—please refer to SOURCE PARAMETERS for details.
- The previously recommended 8'-tall barrier "D" for the Practice Area (i.e., the proposed application of a solid sound-blocking material to the planned chain-link fencing) may or may not be needed, depending on the number of participants and duration of actual instrument play during a practice.

2 SOURCE PARAMETERS

Table 1 shows the four studied event scenarios and the modeled sound source parameters (sound power level [L_W] and height above grade, where grade = 0 = the planned football field [at 482' above mean sea level, for grading plan reference]). Figure 1 shows an isometric view of the CadnaA-based model study area, with callouts identifying the locations of these sources as well as the positions of modeled barriers (e.g., retaining walls, buildings, property line fences, etc.).

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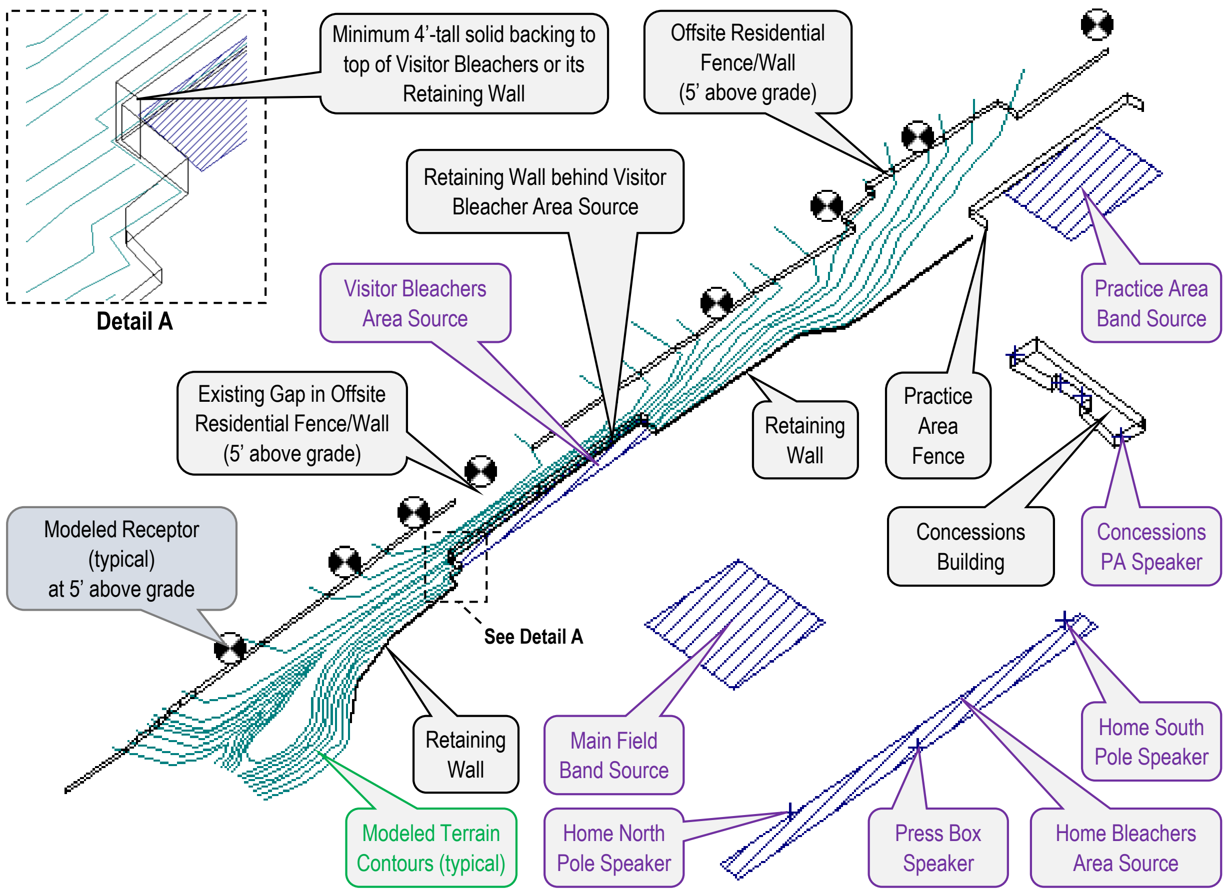

Figure 1. Isometric view (looking southeast, at 45-degree from horizontal) of the CadnaA-based operation noise model features in vicinity of the Visitor Bleachers

Table 1.
Modeled Sound Source Height (above grade*, in feet) and Sound Power Level (L_w)**

Studied Event Scenario	Point Sound Sources										Area Sound Sources							
	Main Field Speakers						*Concessions*				*Bleachers*				*Fields*			
	Home North Pole		*Press Box*		*Home South Pole*		*Intercom*		*Speaker*		*Home*		*Visitor*		*Main*		*Practice*	
	H	L_w	H	L_w	H	L_w	H	L_w	H	L_w	H	L_w	H	L_w	H	L_w	H	L_w
Football Game	50	103	20	103	50	103	10	94	10	94	10	101	10	97	4	0	4	0
Main Field Band Practice	50	0	20	102	50	0	10	0	10	0	10	0	10	0	4	106	4	0
Practice Area Band Practice	50	0	20	0	50	0	10	0	10	0	10	0	10	0	4	0	4	101

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Table 1.
Modeled Sound Source Height (above grade*, in feet) and Sound Power Level (L_w)**

Studied Event Scenario	Point Sound Sources										Area Sound Sources							
	Main Field Speakers						*Concessions*				*Bleachers*				*Fields*			
	Home North Pole		*Press Box*		*Home South Pole*		*Intercom*		*Speaker*		*Home*		*Visitor*		*Main*		*Practice*	
	H	L_w	H	L_w	H	L_w	H	L_w	H	L_w	H	L_w	H	L_w	H	L_w	H	L_w
Halftime Show	50	101	20	101	50	101	10	92	10	92	10	95	10	91	4	106	4	0

* all height values assume the proposed Main Field at 482 feet above mean sea level (amsl) = 0 feet with respect to the Project model
** sound power levels (L_w) are rounded to nearest integer value for purposes of this tabular presentation

Because the event noise scenarios need to comply with the City of Chula Vista exterior noise standard of 55 dBA hourly L_{eq}, the L_w values appearing in Table 1 are correspondingly with respect to an energy-averaged hourly value. By way of example, this means that the indicated input parameter of 101 dBA L_w for the Practice Area Band Practice is not an instantaneous sound level, but value that incorporates temporal considerations for the sound source. The following paragraphs detail assumptions for each of these hourly L_w input parameters upon which the prediction results rely.

Bleachers

The home and visitor bleachers are input as "area sources" in the CadnaA-based model, sized to match the planned seating areas. The difference in area sizes, corresponding with expected greater home bleacher attendance, means the home bleachers will—all else being equal—emit more noise than the visitor bleachers as represented by the L_w values in Table 1. But both bleachers have been defined with a common "per unit area" sound power level that assumes each area unit is one square meter, within which two people may be talking over the course of an average hour. Table 2 presents the assumed average break down of voice effort and duration for each of the two scenarios shown in Table 1 where such crowd noise is an included sound emission source.

Table 2.
Assumed Breakdown of Voice Effort per Spectator Pair in Bleacher Seating Areas

Voice effort per pair of spectators	Reference L_p (dBA) at 1 meter*	Football Game Scenario		Halftime Show Scenario	
		Anticipated cumulative minutes per hour	*Notes*	*Anticipated cumulative minutes per hour*	*Notes*
Normal speech	60	33	spectator chatter	6	spectator chatter
Raised speech	66	3		0	

Table 2.
Assumed Breakdown of Voice Effort per Spectator Pair in Bleacher Seating Areas

Voice effort per pair of spectators	Reference L_p (dBA) at 1 meter*	Football Game Scenario		Halftime Show Scenario	
		Anticipated cumulative minutes per hour	*Notes*	*Anticipated cumulative minutes per hour*	*Notes*
Loud speech	72	2	increased speech sound level during exciting game moments	0	spectators are silent watching band perform
Very loud speech	78	1		0	
Shout	84	0.33	brief cheer upon touchdown(s)	0.2	brief cheer after band performance
Energy-averaged L_p for the full hour		65.7		59.7	

* per "Prediction of Crowd Noise", Table 2 (Hayne 2006)

The presented energy-averaged L_p values for each of the two displayed scenarios in Table 2 are time-dependent combinations of the five listed voice efforts, where the L_p for each would be calculated from the following expression:

Hourly L_p per voice effort = reference L_p at one meter + 10*LOG([cumulative minutes]/60)

These five hourly L_p values per voice effort level are then logarithmically summed to result in the sum appearing in the last row of Table 2. Converted to an L_w value, each of these log-summed hourly L_p values per unit area is used to calculate the L_w for the entire modeled bleacher seating area sound source with the following expression:

Hourly L_p per unit area + 8 + 10*LOG(area in square meters) = L_w for the bleacher seating area

Changes to the assumed cumulative durations appearing Table 2 would result in adjusted full-hour L_p values that would correspondingly change the overall L_w values for the home and visitor bleacher seating areas appearing in Table 1.

Furthermore, speech directivity dB adjustments per Figure 4 of "Prediction of Crowd Noise" (Hayne 2006) was applied to each of the bleacher seating area sound sources, so that sound from the home bleacher spectators tends to travel east, and sound from the visitor bleacher spectators tends to travel west—as one would reasonably expect, given the planned seating orientations facing the athletic field.

Note that these assumptions for estimating crowd noise represent Dudek's effort to reasonably estimate event conditions for the limited purpose of environmental noise assessment and informing the District of potential noise impacts. Responsibility for confirming or adjusting these assumptions, and their consequential effects on the project final design, is with others.

Speakers

The PA speakers and concession area speakers/intercoms appearing in Table 1 are omni-directional “point”-type sound sources. Per CadnaA software defaults, when such sources may be located next to a building surface, they adopt directivity perpendicular to that nearby surface. Dudek understands that final audio design and/or specification of these speakers may feature sound propagation patterns that are not omni-directional and instead focus sound fields within certain directions. While this may be done advantageously as a consequence of project design, the L_w values appearing in Table 1 state what the environmental noise impact assessment modeling has assumed and thus represent “performance standards” or expectations that may inform this design effort.

Marching Band

Outdoor L_p measurements of actual Bonita Vista High School (BVHS) marching band performance were conducted by Dudek in June of 2017 and resulted in 68.8 dBA L_p at 200 feet distance for a band comprising 25 participants. Using this empirical reference data, the following are details of the L_w values used presented in the Table 1 list of modeled scenarios:

- 105.8 dBA L_w = 12.75 minutes of continuous performance in one hour for a 25-participant band
- 105.8 dBA L_w = 5.4 minutes of continuous performance in one hour for a 60-participant band (i.e., this is the “full” band composition, per information from BVHS)
- 100.8 dBA L_w = 12.66 minutes of continuous performance in one hour for an 8-participant band

Other L_w values may be calculated from the reference 68.8 dBA L_p at 200 ft (source [center of band activity] to receptor distance) using the following expression:

$$\text{Reference } L_p + 8 + 20*\text{LOG}(200/3.28) + 10*\text{LOG}([\text{minutes of play in an hour}]/60) + 10*\text{LOG}(\text{participants}/25) = L_w$$

These band-attributed area sources are assumed to be omni-directional with respect to directivity (i.e., sound emits hemi-spherically as it propagates away with distance). Changes to the number of “participants” that comprise the performing band/group and duration of performance (“minutes of play in an hour”) would correspondingly change the calculated L_w to be used as a model input parameter.

3 REFERENCES

Hayne, M. J., et al. 2006. "Prediction of Crowd Noise". Proceedings of ACOUSTICS 2006. 20-22 November, Christchurch, NZ. https://www.acoustics.asn.au/conference_proceedings/AASNZ2006/papers/p46.pdf