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LSTN

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Subject: Sunset Amphitheater in McKinney
Environmental Noise Assessment

Dear Bob,

In this document we summarize our current environmental noise assessment for the development of the Sunset Amphitheater in McKinney, TX.

Please let us know if you or the municipality have any questions.

Yours Sincerely,

Matt Mahon

Matt Mahon

Partner, LSTN Consultants

CC: Ken Andria, LSTN

1 BACKGROUND

- Notes Live (Notes) is developing the Sunset Amphitheater in the southwest corner of Marketplace Dr and Medical Center Dr in McKinney, TX.
- Notes is engaging with the community and seeking relevant planning approvals. As part of that effort, Notes has requested that LSTN provide an environmental noise assessment.
- This document summarizes our current environmental noise assessment.

2 ZONING AND PLANNING

We understand that the project site is subject to the following zoning and planning characteristics:

Zoning	PD (Ordinance No. 2014-02-009)
Overlay	Highway Commercial Overlay District

Exhibit A of Ordinance No. 2014-02-009 specifically anticipates in Section 2.f. that "nightclubs, theatres (indoor or outdoor), and other similar entertainment uses" be allowed.

3 NOISE CODE

We understand that the relevant noise code is captured in the *McKinney, Texas, Code of Ordinances, Subpart A – General Ordinances, Chapter 70 – Offenses and Miscellaneous Provisions, Article V. Noise*.

Excerpts of the relevant clauses from that section are reproduced below for convenience, though refer to the Code of Ordinances and the authorities having jurisdiction directly for any official reading. All formatting is by LSTN for emphasis and clarity. Footnotes and cross-reference have been removed.

Noise Code Text Excerpts

Article V. Noise

Sec. 70-118. Purpose.

The purpose of this article is to establish specific performance standards for the emittance of noise and to make it unlawful for any person or entity to make, cause to be made or allow any loud or unreasonably loud and disturbing noise of such character, intensity and duration as to be detrimental or offensive to the ordinary sensibilities of the inhabitants of the city, and/or which renders the enjoyment of life, health or property uncomfortable or interferes with public peace and comfort.

Sec. 70-119. Definitions.

(a) The following words, terms and phrases, when used in this article, shall have the meanings ascribed to them in this section, except where the context clearly indicates a different meaning:

[…]

***Daytime hours** refers to the hours between 6:00 a.m. and 9:00 p.m. on any given day.*

[…]

Device *means any mechanism which is intended to produce, or which actually produces, noise when operated or handled.*

[...]

Noise disturbance *means any sound which annoys or disturbs, or which causes or tends to cause an adverse psychological or physiological effect upon, the sensibilities of a reasonable, prudent, adult person; and unreasonably loud or disturbing noise which renders the enjoyment of life or property uncomfortable or interferes with public peace and comfort.*

Noise disturbance per se *means not requiring extraneous evidence or support to establish the existence of a noise disturbance.*

Noise measurement *means the measurement of noise using a sound level meter meeting the standards prescribed by the American National Standards Institute.*

Nonresidential district *means any district not classified by the zoning ordinance as containing residential homes, apartments or condominiums.*

[...]

Property *means any lot, tract, parcel of land or a portion thereof, occupied or unoccupied, improved or unimproved, public or private within the corporate limits of the city.*

Property boundary *means an imaginary line exterior to any enclosed structure, at the ground surface and its vertical extension, which separates the real property owned by one person from that owned by another person.*

[...]

Residential district *means any district classified by the zoning ordinance as containing residential homes, apartments or condominiums.*

[...]

(b) All terminology used in this article and not specifically defined above shall retain its meaning in conformance with applicable publications of the American National Standards Institute (ANSI) or its successor body and/or the latest volume of Webster's Collegiate Dictionary.

[...]

Sec. 70-120. Specific performance standards for noise.

All uses in all districts shall conform in operation, location, and construction to the specific noise performance standards listed below. For the purpose of noise measurement, the "bounding property line" shall be the nearest property line of the property on which the noise is being generated.

(a) At no point at the bounding property line of a residential use shall the sound pressure level of any operation or activity exceed 65 dB(A) for daytime hours and 58 dB(A) at nighttime.

(b) At no point at the bounding property line of a nonresidential use shall the sound pressure level of any operation or activity exceed 70 dB(A) for daytime hours and 60 dB(A) at nighttime.

(c) Exemptions. The following uses and activities shall be exempt from the specific performance standards for noise:

(1) Noises not directly under control of the property user;

(2) Noises emanating from construction and maintenance activities during daytime hours;

(3) Noises of safety signals, warning devices, and emergency pressure relief valves;

(4) Transient noise of moving sources such as automobiles, trucks, airplanes, and railroads;

(5) Noises necessary to immediately and reasonably prevent the threat of bodily injury, death, or loss of property;

(6) Noises produced by lawfully scheduled events in full compliance with all issued permits including, but not limited to:

a. A stadium or sporting event;

b. A school-sponsored event;

c. An amphitheater event;

d. A musical performance;

e. An event, fun run, race, festival, fiesta, or concert that was sponsored or co-sponsored by the city; and

f. A special event as defined by the Code of Ordinances.

(7) Reasonable activities conducted in public parks, public playgrounds, or public or private school functions; and

(8) Noises produced as part of the provision of municipal services.

Sec. 70-121. Noise disturbances.

I. Specific noise disturbances prohibited.

(a) No person shall allow, make or cause to be made any unreasonably loud or disturbing noise that is offensive to the sensibilities of a reasonable, prudent adult person, renders the enjoyment of life or property uncomfortable, interferes with public peace and comfort, or causes a noise disturbance as defined in this article.

(b) The following includes, but is not limited to, activities which can create unreasonably loud or disturbing noises in violation of this article, including activities which are noise disturbances per se, unless an exemption exists or a permit of variance was first obtained as provided herein, or the noise emitted is consistent with or within the parameters of section 70-120.

[…]

(2) Radios, television sets, musical instruments, loudspeaking amplifiers and similar devices.

[…]

b. The using, operating or permitting to be played, used or operated any sound production or reproduction device, radio, receiving set, musical instrument, drums, phonograph, television set, loudspeaker and sound amplifiers or other machine or device for the producing or reproducing of sound within a nonresidential area in such a manner as to cause a noise disturbance.

[…]

(c) In the event a conflict exists between the specific performance standards for noises set forth in section 70-120 and the specific noise disturbance prohibited set forth in section 70-121, the performance standards contained in section 70-120 shall control.

II. Exemptions.

(a) The following sources of potential noise disturbance shall be exempt from the regulations of this section:

(1) Safety signals, storm warning sirens or horns and the testing of such equipment, emergency vehicle sirens or horns used when responding to an emergency, and emergency pressure relief valves;

(2) Sound caused in the performance of emergency or public service work, including police, fire and public utility operations, acting in the performance of lawful duties to protect the health, safety or welfare of the community;

(3) Sounds caused by natural phenomena;

(4) Activities conducted on public parks and playgrounds which are approved, sponsored or sanctioned by the city. Activities conducted on public or private school grounds including, but not limited to, school athletic and school entertainment events which are approved, sponsored or sanctioned by the school; and

(5) Any activity, noise or sound exempted under section 70-120(c).

III. Permits of variance.

(a) The director of public safety, or their designated representative, is authorized to grant permits for relief of any provision in this section on the basis of undue hardship in cases where:

(1) The sound source will be of short duration and the activity cannot be conducted in a manner as to comply with this article;

(2) Additional time is necessary for the applicant to alter or modify their activity or operation to comply with this article; or

(3) No reasonable alternative is available to the applicant.

(b) A special events noise variance permit allowing specific deviations from this section may be issued by the director of public safety, or his designated representative, without a demonstration of undue hardship, for events of limited duration (not to exceed seven days) which, in the opinion of the director, promote identifiable historical, cultural, artistic, economic development, or community goals (including, but not limited to, the promotion of community activity in the commercial historic district), including conditions for the variance specific to the use; provided that any noise disturbance created by such activity will be abated when such request is made by the director, or his designated representative. The fee in subsection (e) of this section shall apply to any permit issued.

(c) An automatic variance will be granted without the payment of permit fees for the purpose of conducting parades or other public events; provided that any noise disturbance created by such activity will be abated when such request is made by the director of public safety, or his designated representative.

(d) The director of public safety, or his designated representative, may prescribe any reasonable conditions or requirements deemed necessary to minimize adverse effects and may suspend any permit issued for violating any provisions prescribed in the permit of variance.

(e) A fee as determined from time to time by city council shall be charged to each applicant for processing permit applications.

IV. Appeals.

(a) Any applicant who has been denied a permit of variance or any permittee whose permit has been suspended, shall have the right to a hearing before the city manager.

(b) Request for a hearing shall be made in writing and received by the director of public safety, or his designated representative, within ten days of the date of the denial or the date of the notice of the suspension. The city manager may review the appeal at a staff level and has the authority to reject the action of his designated representative and order that a permit be granted or to reinstate a suspended permit. However, should the city manager uphold the denial or suspension of a permit, he shall, or his designated representative shall, schedule a hearing within 30 days of receipt of the request.

(c) The city manager shall have the authority to review all pertinent files and information regarding the applicant/permittee which are in the custody of the director of public safety, or his designated representative. Additionally, the city manager shall have the authority to accept written and verbal testimony from the director of public safety, his designated representative, any appropriate city staff member, applicant/permittee and interested citizens. The city manager shall also have the authority to place time restrictions on the testimony to be given at the hearing.

(d) The city manager shall have the authority to assess whether the director of public safety, or his designated representative, acted properly within the powers granted under this article in the denial or suspension of a permit. Upholding the action of the director of public safety, or his designated representative, shall affirm the denial or suspension. Rejection of the action of the director of public safety, or his designated representative, shall automatically grant a permit or reinstate a suspended permit.

(e) No person whose permit has been denied or suspended, shall create or allow the creation of the noise disturbance in dispute prior to a determination by the city manager.

Sec. 70-122. Penalty.

Any person violating any of the provisions of this article shall be deemed guilty of a misdemeanor, and upon conviction thereof shall be punished by a fine not to exceed $500.00. A separate offense shall be deemed committed upon each day during or on which a violation or failure to comply occurs or continues to occur. Allegation and evidence of a culpable mental state is not required for the proof of an offense defined by this article.

Sec. 70-123. Injunctive relief.

In addition to and accumulative of all other penalties, the city shall have the right to seek injunctive relief for any and all violations of this article.

[…]

Noise Code Interpretation

The following is our synthesized interpretation of the noise code, which should be confirmed with the relevant authority having jurisdiction:

- If events at the amphitheater are lawfully scheduled in compliance with all issued permits, there are no applicable specific performance standards, and the event shall not be expressly prohibited.
- If permits are not secured, events are not prohibited provided the following specific performance standards are adhered to:

	Sound Pressure Level	
	At Residential Receiver Property Line	At Nonresidential Receiver Property Line
Daytime 6:00am – 9:00pm	65dB(A)	70dB(A)
Nighttime 9:00pm – 6:00am	58dB(A)	60dB(A)

- If Notes can demonstrate to the Director of Public Safety or their designee that the events promote cultural and economic goals, permits may be issued (without demonstrating hardship, and provided events do not exceed sever days).
  - It should be confirmed that the operator's anticipated schedule meets the definition and spirit of "limited duration."
  - It should be confirmed either that multiple permits may be issued to Notes over the course of a season or that because individual events do not exceed seven *sequential* days that one permit may cover a season.

4 VENUE PROGRAMMING AND SOUND SYSTEM CHARACTERIZATION

To clarify the expected environmental impact of the venue, we here characterize the expected use of the venue and its proposed sound system.

The noise levels expected to be generated at the amphitheater during events will relate to two primary factors:

- The types of events produced
- The types of sound systems used

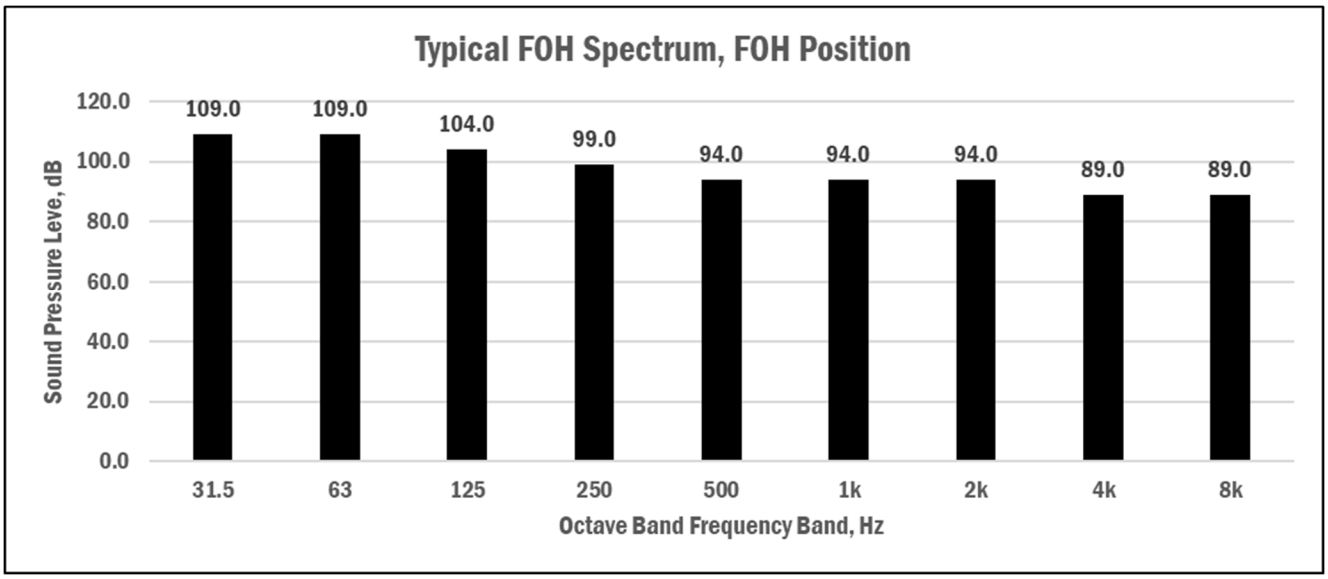
Notes propose to operate an amphitheater that will host live musical performances. The venue may host stand-alone productions and events but will primarily host tours that travel between similar venues to different regions.

For an idea of the programming for such a venue, consider the recent performers at the popular Red Rocks Amphitheatre outside of Denver, CO, reproduced here. The performances include a mix of Rock, Pop, Hip Hop, Electronic, and Folk genres.

Such performances rely on sound systems to amplify/reinforce sound produced on stage for the audience. The music performed is typically broad spectrum, i.e. it includes sounds across the audible frequency spectrum.

The level and spectrum of sound varies temporally throughout a performance and will differ broadly between different performance types (e.g. Electronic and Hip Hop performances typically have higher levels of low frequency sound than folk music).

Despite significant variation, we can make reasonable assumptions about the typical frequency spectrum and sound level produced for typical events to facilitate estimating environmental noise. The spectrum below corresponds to 100dB(A) of broadband sound, which would be a reasonable level for a performance to reinforce at the front of house (FOH) mix position, ~100ft from the stage. Note, these would be common levels to reach and briefly exceed periodically during a single song (not average levels).



It is typical for acts touring venues of this type to travel with a main sound system which would be deployed to each side of the stage.

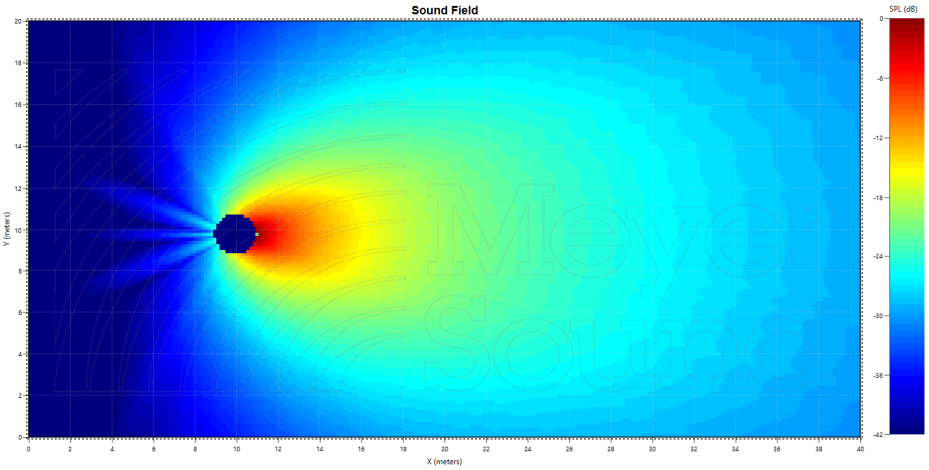
Tours typically deploy line array-type main loudspeakers. Line arrays consist of individual loudspeaker cabinets that are arrayed vertically together, as shown above.

Subwoofers are often hung in vertical arrays as shown in the left two images above. But sometimes they are stage-stacked as shown on the right.

The primary function of a sound system is to provide adequate sound level to the audience. Sound should also be consistent across the audience, i.e. not too loud at the front and too quiet at the back.

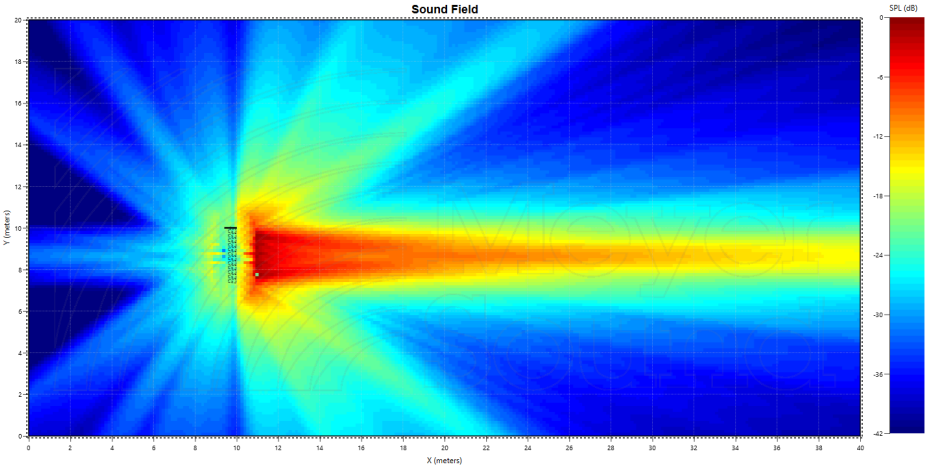
In addition to sound power output, a core characteristic of loudspeakers is directivity—How much sound energy the loudspeaker emits in different directions.

The physical design of line array loudspeakers inherently provides wide, even coverage over typical festival and amphitheater audience areas and limits noise spill in other directions.



Typical Horizontal Line Array Directivity

Note the line array's ability to limit sound emissions in the vertical plane to the axis of the loudspeaker—Little sound is "wasted" off axis. Though tours carry line array loudspeakers with different manufacturers, detailed specifications, and quantities, in practice the variation between typical line arrays is not significant.



Typical Vertical Line Array Directivity

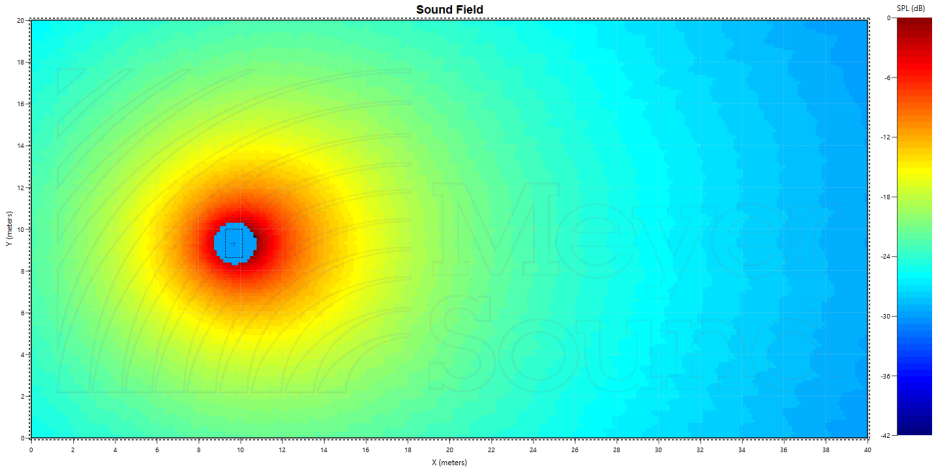
The analysis presented here was based on a Meyer LEO-M loudspeakers and is representative of all common touring line arrays (D&B, L'Acoustics, JBL, EAW, Nexo, Clair, etc)

Subwoofer systems have greater variation in their physical deployment (as shown in the photos above) and in their interior construction that can impact their directivity.

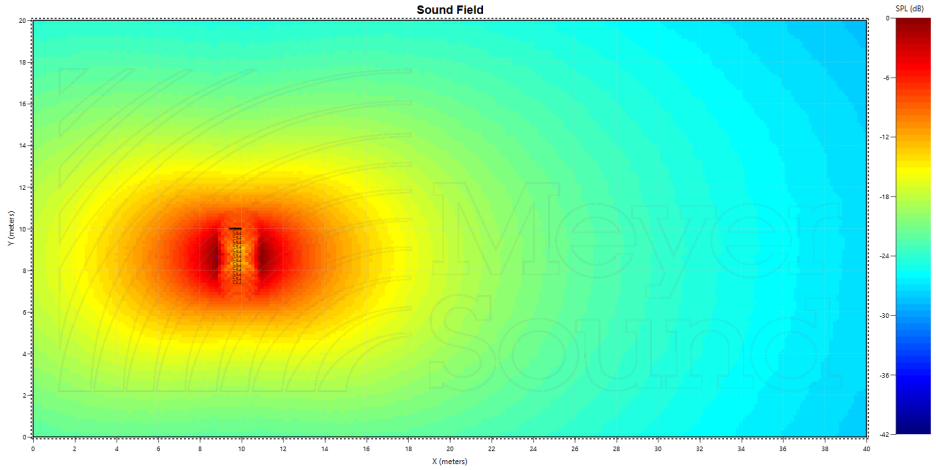
A basic individual subwoofer is effectively omnidirectional (in the vertical and horizontal planes).

When you array basic subwoofers vertically (like the line array loudspeakers), the subwoofer array exhibits pattern control in the vertical direction. In plan, the directivity is effectively unchanged.

Cardioid directivity for subwoofers can be accomplished with either inherently cardioid subwoofer cabinets or by reorienting subwoofer cabinets in array. There is significant variation on the methods to achieve cardioid subwoofer directivity.



Typical Omnidirectional Subwoofer Directivity



Vertical Array Subwoofer Directivity

5 ENVIRONMENTAL NOISE MITIGATION

Incorporating mitigation measures can help reduce environmental noise. Noise emissions to the surrounding environment can be mitigated the following factors:

- Physical Mitigation
- Electroacoustic Mitigation
- Operational Mitigation

Physical Mitigation

The proposed amphitheater is located in the southwest corner of Marketplace Dr and Medical Center Dr in McKinney, TX, The site is in the northeast corner of McKinney's intersection of US75 and TX121.

The site's location adjacent to the major roadways employs good planning practice—The site and nearby environs are already impacted by noise from the roadways. The natural terrain is generally flat, but the raised rake of the seating bowl will reduce noise emissions north-east.

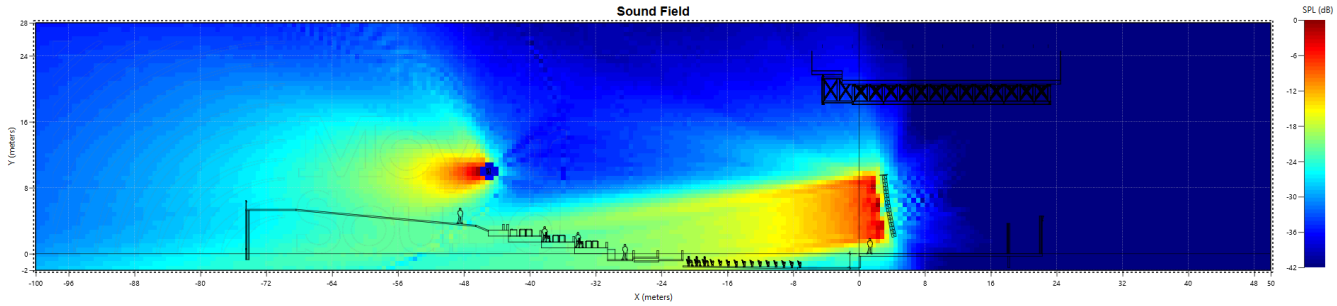
Most surrounding properties are zoned PD (planned development district). The nearest property zoned expressly residential is a multifamily development approx. 2,500ft to the east/south-east. However, there is multifamily and single family housing, hotels, and other commercial uses nearer, approx. 1,400ft.

Electroacoustic Mitigation

The types of loudspeakers typically used for performances demonstrate inherent benefits for the control of environmental noise:

- Sound from line arrays is vertically controlled to allow directing sound to the audience, without sending sound higher vertically or beyond the venue footprint horizontally. This will reduce noise emissions from the amphitheater.
- Some subwoofer systems may be deployed in configurations to affect a cardioid directivity. This will reduce low frequency noise spill to the rear of the stage.

To further reduce sound system noise spill, the design proposes to incorporate house delay loudspeaker clusters that would be located at the front of the lawn seating (as illustrated in the conceptual mapping below). By using delay clusters, all loudspeakers (main loudspeakers at stage and delay clusters) may be operated at a lower overall sound power thus reducing overall noise emissions.



Aggregate Effect

The Physical and Electroacoustic mitigation measures described above are expected to reduce environmental noise emissions from the amphitheater. In the table below, we summarize initial analysis of the benefits of the physical and electroacoustic mitigation measures.

Magnolia Branch development ~1,400ft E-NE	Noise Levels in Decibels (dB) at Octave Band Center Frequency (Hz)									
	32	63	125	250	500	1k	2k	4k	8k	Overall
FOH Mix Position	109	109	104	99	94	94	94	89	89	100dB(A)
Without Mitigation	86	86	81	76	70	69	68	57	36	75dB(A)
With Physical and Electroacoustic Mitigation	86	85	79	70	61	64	61	49	26	70dB(A)

El Lago development ~1,400ft W-NW	Noise Levels in Decibels (dB) at Octave Band Center Frequency (Hz)									
	32	63	125	250	500	1k	2k	4k	8k	Overall
FOH Mix Position	109	109	104	99	94	94	94	89	89	100dB(A)
Without Mitigation	86	86	81	76	70	69	68	57	36	75dB(A)
With Physical and Electroacoustic Mitigation	86	84	76	66	56	52	46	31	5	64dB(A)

Coventry Point development ~3,300ft N-NW	Noise Levels in Decibels (dB) at Octave Band Center Frequency (Hz)									
	32	63	125	250	500	1k	2k	4k	8k	Overall
FOH Mix Position	109	109	104	99	94	94	94	89	89	100dB(A)
Without Mitigation	79	79	73	68	61	59	55	36	0	65dB(A)
With Physical and Electroacoustic Mitigation	79	78	72	64	54	55	50	30	0	62dB(A)

These results are typical for outdoor amphitheaters—High frequency sounds are well attenuated by loudspeaker orientation and directivity, barriers, and air absorption at reasonable distances from the amphitheater. Low frequency sounds are the hardest to reduce at distance.

Operational Mitigation

In addition to the physical and electroacoustic mitigation described in the preceding sections, we propose that the amphitheater should adopt additional operational mitigations strategies. These are appropriate both as a good faith effort as a member of the community and to address the limitations of the physical and electroacoustic mitigation strategies:

- Some productions may be inclined to operate sound systems at noise levels in excess of our assumed spectrum.
- Weather events (wind, temperature inversions) may cause noise emissions in excess of those estimated here.

As such, the following specific operational mitigation strategies have been developed with Notes:

Operating Hours	• Sunday through Thursday
	  • Events would typically occur during the evening.
	  • Performances would typically begin between 7-8pm.
	  • Sound check would begin after 3pm.
	  • Performances would end not later than 11:00pm.
	• Friday and Saturday
	  • Events would typically occur during the afternoon and evening.
	  • Performances would typically begin between 3-8pm.
	  • Sound check would begin after 12pm.
	  • Performances would end not later than 11:00pm.

Controls on Touring Sound Systems	• The main loudspeakers of touring sound systems are expected to be line-array type. • The main loudspeakers and subwoofers would be rigged no higher than 40ft above stage. • Where practical, subwoofers can be arrayed to provide low frequency directivity. • Performances are expected to make use of permanently installed delay cluster loudspeakers. Main loudspeakers would be rigged and aimed only to serve the lower, seated sections.

Noise Monitoring and Performance Controls	**The amphitheater is expected to establish operational maximum sound levels for performances and if performances exceed these levels, active steps would be taken to reduce noise levels.**
	• Noise monitoring would be conducted during performances at the FOH Mix position. The limits at FOH are expected as follows:
	  • The broadband noise levels measured at the FOH mix position:
	  • The broadband noise levels measured at the FOH mix position:
	  • An L10 exceeding 105dB(A) in any 30 minute period.
	  • An L90 exceeding 98dB(A) in any 30 minute period.
	• Should noise levels exceed those documented above, the venue operator would promptly inform the event production team and instruct the event production team to reduce noise levels to a level appropriate to maintain the requirements.
	• Event production teams are expected be obligated by their contracts to comply with the venue operator's directions and may be subject to prematurely terminating events if the performance remains out of compliance.

6 NEXT STEPS

We propose the assessment here be reviewed with the city. Following relevant approvals, we expect to further develop the details of these mitigation strategies into the architectural design for the project.