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August 2, 2023

Mr. Darren Nielsen
Vice President/KC Studio Leader
HNTB
715 Kirk Drive
Kansas City, MO 64105

VIA EMAIL: dnielsen@HNTB.com

Subject: Northwestern University Ryan Field
Environmental Assessment Review and Summary

Dear Mr. Nielsen;

As requested, WJHW has assembled the following report for Northwestern University regarding the Ryan Field redevelopment. Northwestern previously engaged Henderson Engineers to complete on-site sound level measurements as well as modeling of future sound generated by the stadium using environmental sound analysis software.

Acoustic Terms and Definitions

The following terms and definitions are used in this report.

Decibel (dB): A unit of measure of the loudness of sound based on a logarithmic scale of the ratio of sound pressure magnitude to a standard reference pressure. Higher decibel levels generally relate to higher perceived sound levels. Since dB is based on a logarithmic scale, the addition of dB versus the perceived sound level increase is not linear. The following are perceived sound level differences compared to the increase/decrease of dBs.

0-1 dB	Imperceptible Sound Level Change
3 dB	Just Noticeable Sound Level Change
5-6 dB	Clearly Noticeable Sound Level Change
10 dB	Perceived as Doubling/Halving of Sound Level

Equivalent Continuous Sound Pressure Level (Leq): The steady-state sound level with equal energy to a fluctuating sound pressure level of a sound source over a given time period. This approximates the average sound level over a defined time period, and throughout this report we often use the term average and Leq interchangeably.

A-Weighting: A-weighted sound levels are a single-number summation of sound across the frequency spectrum with corrections applied to each octave or third-octave band. It is used as an expression of the relative loudness of sounds as perceived by the human hearing mechanism. Humans are not equally sensitive to all frequencies, so A-weighting provides greater emphasis to mid/high frequencies (where our ears are most sensitive) and less to low frequency sound. A-weighting scales are commonly used in environmental sound assessments and municipality ordinances as they have been found to better correlate to annoyance of sound sources to human related activity. The majority of sound ordinances encountered are based on the A-weighting metric. When using the A-weighting scale, an "A" is added to the given metric; for instance, dBA or LAeq.

C-Weighting: The C-weighted sound levels are similar to the A-weighted sound levels, with a different correction factor that does not prejudice against low frequency sound. C-weighting is useful in analyzing low frequency sound sources in the environment, such as heavy industrial equipment or the bass content in amplified music. Due to the additional low frequency energy content, C-weighted results are often higher than A-weighted sound levels. When using the C-weighting scale, a "C" is added to the given metric; for instance, dBC or LCeq.

L10: A statistical descriptor of the sound level exceeded 10% of the time. This descriptor is often used to show a "common" high noise level limit while eliminating some of the more unique peak or maximum noise levels measured during a given time period. This is often helpful in eliminating isolated noises that are not common to the event being measured (e.g. emergency vehicle siren).

L90: A statistical descriptor of the sound level exceeded 90% of the time. This descriptor is often used to show a "common" low noise level limit while eliminating more extreme quiet times during a measurement period.

Ambient Sound: The entirety of the sound associated with a particular environment excluding the specific osund source(s) of interest. This is often referred to as background sound and may include sound sources such as transportation (local traffic, aircraft, trains), animals (birds, frogs, insects), building systems (nearby mechanical units), and human other activity.

ANSI: American National Standards Institute

Daytime: The time between 7:00 am and 10:00 pm. Some ordinances define daytime ending at 7:00 pm, but the majority of ordinances include the later time.

Nighttime: The time between 10:00 pm and 7:00 am, unless specifically defined otherwise. Nighttime sound level requirements are typically lower than daytime sound levels so as to avoid sleep disturbance.

Sound Frequency Spectrum: The makeup of sound frequency and level for a particular sound source. Every sound has a unique frequency content which makes it identifiable. This may range from a single frequency (pure tone) to a complex combination of frequencies (musical chord or speech). A frequency spectrum may be described in single frequencies, octaves, or 1/3-octaves.

Octave: The frequency interval between a defined frequency and its double or half. In acoustics, octaves are set at specified center frequencies (e.g. 125, 250, 500, 1000, and 2000 Hz). Each octave center frequency is a doubling of the previous. Third-octaves split each of those octave bands into three (e.g. 100 Hz, 125 Hz, and 160 Hz make up the three third-octaves in the 125 Hz octave band).

Hertz (Hz): Used to measure the frequency of vibration (sound), Hertz is equal to one cycle per second. Each frequency can be related to a unique tone or musical note. For example, middle C on a piano is approximately 256 Hz.

The information below summarizes the results and data collected and developed by Henderson Engineers and includes comments on the potential impact of sport and concert activities at the stadium on the surrounding communities. Information contained herein is based solely on the data presented by Henderson and no additional analysis was conducted.

Site Sound Measurements During Football Game Day and Non-Event Days

Henderson Engineers conducted a series of environmental sound measurements at and around the Ryan Field property. Measurements were conducted both during game day (football) and non-game day times to identify environmental sound levels and establish current sound levels experienced in the surrounding residential areas.

Both long-term and short-term (spot) measurements were conducted during two separate measurement periods. Game day sound measurements were conducted over the weekend of October 7-10, 2022. A second set of measurements were conducted on a non-game day weekend, December 2-4, 2022, to establish current ambient sound levels in the residential communities. Measurements were made at the stadium property as well as through the surrounding neighborhoods.

Measurement equipment information and location descriptions are summarized in Appendix C. Equipment used for the survey achieves, at minimum, requirements from ANSI standards to complete this assessment.

Figures 1 and 2 show the time history results of the sound measurements on game day and non- game day weekends, respectively. Data presented is for 10-minute LAeq values.

Figure 1: Time History of LAeq Values during Game Day Activities (October 7-10, 2022)

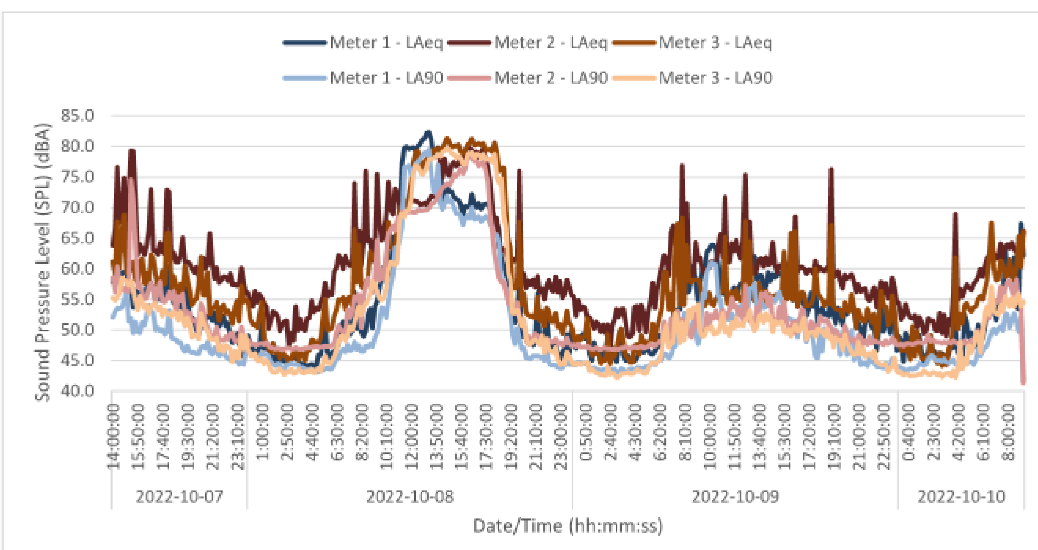
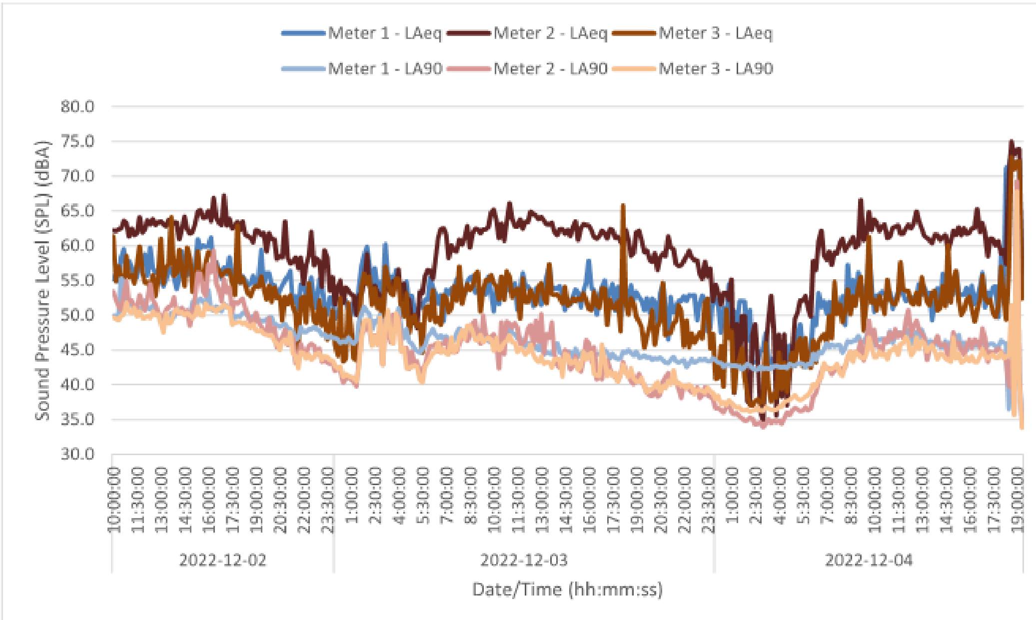


Figure 2: Time History of LAeq Values during Non-Game Day Activities (December 2-4, 2022)



A review of the measured sound data during the game day weekend at the existing stadium shows an increase in sound levels on Saturday, October 8, during the time the football game and associated activities[1] would occur. Reviewing the graph, it shows sound levels begin increasing rapidly around 9-10 am and continue through game time before subsiding around 6pm. The levels on Saturday are higher than the Sunday, October 9, sound levels and are indicative of the sound generated at the stadium compared to typical ambient sound. Further, the sound measurements taken during a non-game day weekend confirm the typical ambient sound levels in the area are consistently lower than the measured pre-game/game activity at the existing stadium. It is shown in these figures that the current weekend daytime ambient sound levels are around 60-65 dBA, and that game day activities increase sound levels up to 70-80 dBA, notably for a period of time that extends beyond just the football game itself.

It should be noted the sound monitoring positions during game day measurements were located on the Ryan Field/Northwestern University property and were identified as tailgating activities, music in the parking lot(s), and large crowds. As the measurement locations are essentially “within” the sound source, these are considered the highest sound levels in the area. Sound level will diminish at some rate[2]as it moves into the residential communities meaning the actual stadium sound impact may be less in the neighborhoods as compared to what was measured in the parking lots.

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[1] “Football game and associated activities” include game play noise sources (such as whistles), PA announcements, crowd noise/cheering, tailgating activities (such as music), and general crowd activities.

[2] The rate of sound reduction due to distance in open space is calculated by 20 Log (D1/D2) where D1 and D2 are the distances from the sound source to the measured and predicted locations, respectively. Based on this calculation, a 6 dB reduction is achieved for every doubling of distance. The textbook definition of sound falloff is not always achieved in real life – due to numerous environmental conditions including weather, source directionality, and the physical and built environment – and therefore reductions of 4 or 5 dB per doubling of distance may occur.

For the neighborhoods, the better comparison of stadium sound to ambient sound can be made with the “spot” measurement data. Henderson completed a series of short-term sound measurements on October 8 during the football game at various neighborhood locations to the east, south, and west of the project property. Measured LAeq values in these areas averaged between 50-65 dBA and are not appreciably greater than the typical ambient sound levels measured on a non- game day weekend (Figures 1 and 2) which indicate sound levels between 50-65 dBA during the same time period as the game day football activities. While this does not indicate the football stadium activities are inaudible, it does show that they do not add appreciably to the typical daytime ambient sound levels in the neighborhoods. The exception would be those residential properties nearest the stadium (along Central Street, Eastwood Avenue, and Asbury Avenue) which may be more greatly impacted by stadium sound (from loudspeakers and cheering spectators) and parking lot sound (due to increased traffic, tailgaters, and fans).

In summary, the on-site sound measurements at the football stadium during non-game day activities indicate the typical daytime ambient sound levels are between 50-65 dBA. During game days at the existing stadium, sound levels increase at the stadium property and these activities are audible within the surrounding residential neighborhoods. However, the stadium sound – as spot measured during the October 8 football game – generally falls into the ambient sound levels within the surrounding community. We reiterate that stadium sound is not inaudible at the residences, but it does not appear to appreciably add to the typical ambient levels therein.

Notable New Stadium Design Elements

The following best practice design elements are currently included in the stadium design.

1. <u>Utilize a distributed house sound system within the seating bowl</u>

   A distributed sound system is one in which loudspeakers are spread apart across the entire venue to provide sound coverage to spectators; this differs from the older “cluster” systems which require a single set of speakers (one location, often near the scoreboard) which covers the entire stadium. We understand the current sound system at the existing stadium is a single cluster at the north end zone with a few fill speakers throughout the seating bowl. This type of design has been found to lead to more community concerns due to the high sound levels required to cover the entire spectator area. The new stadium design includes a distributed speaker system. This type of system has several important benefits including: a) bringing sound sources closer to the audience so the loudspeakers do not have to be operated at as high a volume to achieve the same level and intelligibility in the stands, b) better control of sound to the audience and less sound emitted to the environment/community, and c) ability to control which speakers are used during smaller events therefore limiting the potential impact on the surrounding communities. Including this sound system design will be helpful in reducing community sound impact and will likely result in less sound emission to the surrounding communities.

2. <u>Provide a canopy above the seating areas that provides adequate sound reduction characteristics</u>

   Providing a canopy above the seating bowl – as currently designed – narrows the aperture through which sound can be emitted to the environment and creates an acoustic "shadow" to the nearest residential properties. The acoustic shadow is an area wherein sound waves fail to propagate due to a barrier and thus sound levels are lower (similar to a light shadow that is blocked by an opaque barrier). Reducing the amount of sound energy emitted to the community will reduce the overall impact of the stadium sound levels on the residences and would be considered an improvement over the existing stadium.

3. <u>Enclosures and Walls around the seating bowl that helps reduce sound emissions to the community</u>

   Strategically placed vertical barriers are included in the proposed stadium design which help block sound from within the seating bowl (include concert setups and crowd noise) from directly transmitting to the residential communities. This is an improvement compared to the current stadium which is more open, thus allowing sound to more easily radiate to the nearby homes.

While not eliminating sound emanating completely from the new stadium, the new stadium design elements will be helpful in reducing sound in the neighboring communities when compared to the open nature of the current stadium with a cluster sound system. We would expect that these design features, combined with lower capacity, will ultimately result in less sound exposure to the residential properties surrounding the stadium compared to the current experience.

Concert Sound Analysis

Henderson Engineers completed an analysis of the potential concert sound impact on the surrounding community utilizing an industry standard modeling software, CadnaA, which calculates sound propagation according to standards including ISO 9613. This analysis was conducted on the new stadium design, including the design features noted above. This software, utilizing inputs related to sound source location, directionality, and level as well as architectural barriers (including buildings), provides an idea of the sound transmission levels to various locations around the stadium. While regulatory ordinances and statutes, and industry standards typically reference dBA levels, the projected dBC levels have been modeled as well at the request of the City of Evanston. The analysis results are shown for dBA values in Figure 4 and dBC values in Figure 5.

For the concert analysis, the following specific facility setup (typical for stadium concerts for the noted capacity) and conditions are included:

- Stage was set on the south end of the field
- Front-of-house sound board/mixing position was set at approximately 100 feet from the stage front
- A line array speaker system[3] was suspended above the field; the top of the speaker stack is approximately 56 feet above field level (see Figure 3)
- Sound level at the sound board was set at 101 dBA
- A pop music frequency spectrum was utilized as the sound source
- The environmental sound modeling software (i.e. CadnaA) assumes adverse wind conditions in all directions related to the sound source per ISO 9613 (the standard to which the noise modelling is based). That is, for modelling purposes, wind moves outwardly in all directions from the sound source as the worst-case. Other adverse conditions (including air temperature, humidity, temperature inversions, etc.) are not included in the model.

Figure 3: Example of Line Array Speaker

[3] A line array speaker system utilizes a series of speaker units (drivers) arranged vertically to create a near-line source. These systems can be configured to help steer sound to the audience which can also limit sound transmission to the environment. These are the standard speaker types used in touring concerts.

Figure 4: Concert Environmental Assessment Results (dBA)

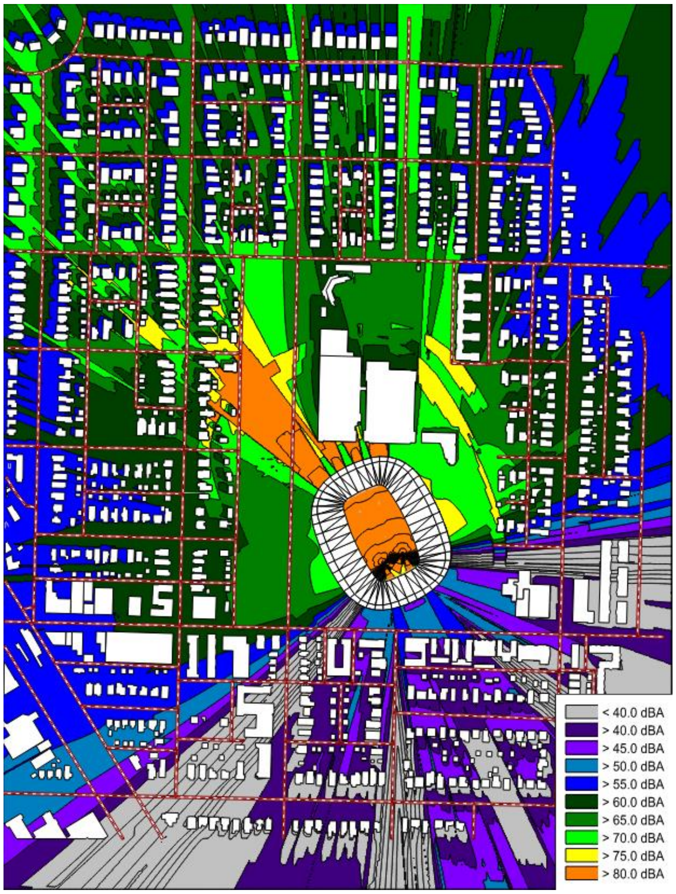
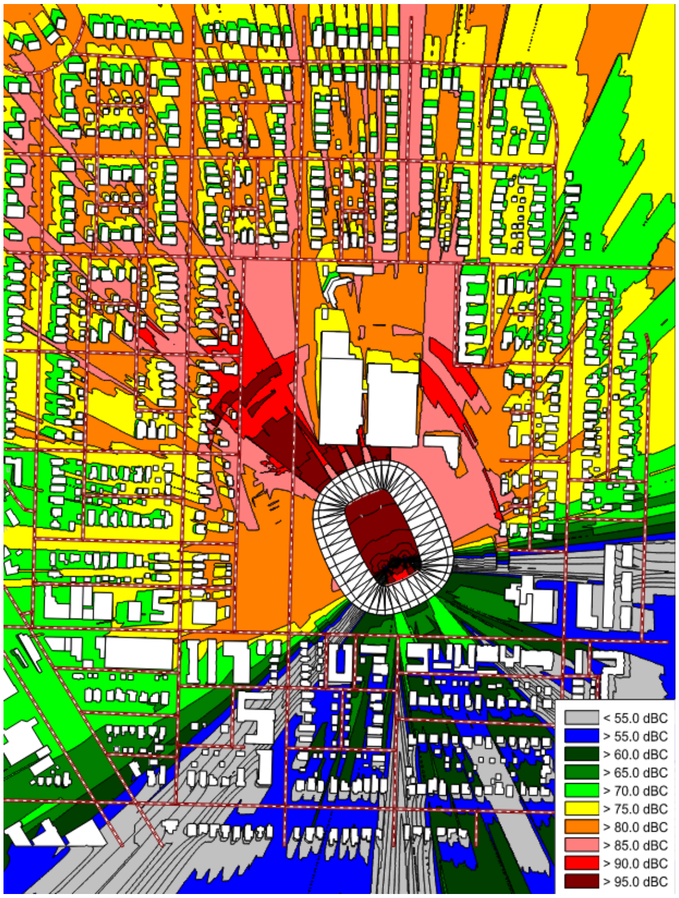


Figure 5: Concert Environmental Assessment Results (dBC)



The results of this analysis show that most sound generated at the new stadium is projected to the north and west. Areas to the east and south also show sound impact, but less so than to the north. Sound transmission to the south could be described as noticeable but generally does not substantially exceed the ambient sound levels measured in the area. Alternative stage locations do not appear to be an attractive option for sound mitigation, given the sound reduction benefits of the building barrier effect related to Welsh-Ryan Arena and other existing Northwestern structures. That is, the existing structures help block/shield transmission to the north residential properties; there is no such barrier at the south of the property to provide the same barrier effect to those southern residences.

Predicted sound levels are approximately 55-75 dBA and 85-95 dBC; dBA levels will reach similar peak levels to those measured for game day activities at the existing stadium. Levels associated with concerts, while elevated, are expected to occur for shorter aggregate periods of time than football game day activities, though they may be more consistent during that period. We estimate the typical concert to be approximately 3-4 hours (doors open to end of encore), less than the 6-8 hours observed for game day events.

Projected concert sound levels were evaluated at the surrounding property lines. The Henderson model accounts for disruption to sound patterns caused by University-owned structures as well as structures approximately two to three blocks beyond the property line. The model does not account for the impact of residential buildings or other structures beyond the model limits shown in the figures above, however, sound levels will continue to dissipate when factoring in the impact of other structures, distance, directivity, and other factors.

The Henderson model results shown above do not account for any additional sound mitigation efforts beyond the two design features noted above.

Additional Sound Barrier Mitigation Option

Many stadiums across the country utilize additional sound barriers around the concourse areas or other openings in the stadium building shell as a mechanism to further contain sound within the facility. These barriers can be utilized effectively when a stadium is not fully enclosed.

Similar to the canopy, adding vertical barriers around open concourse or other areas will reduce the amount of sound that can be directly transmitted to the community. Vertical barriers may be most effective on the east, south, and west facades of the stadium. Options may include permanent barriers or retractable barriers (such as sound curtains, demountable walls, or operable partitions) that narrow the side openings at the stadium.

Henderson adjusted the sound model to account for these types of mitigation efforts; results of these updates to the sound model are shown in Figure 6 (dBA) and Figure 7 (dbC), below, for concerts.

Figure 6: Concert Environmental Assessment Results with Additional Sound Mitigation (dBA)

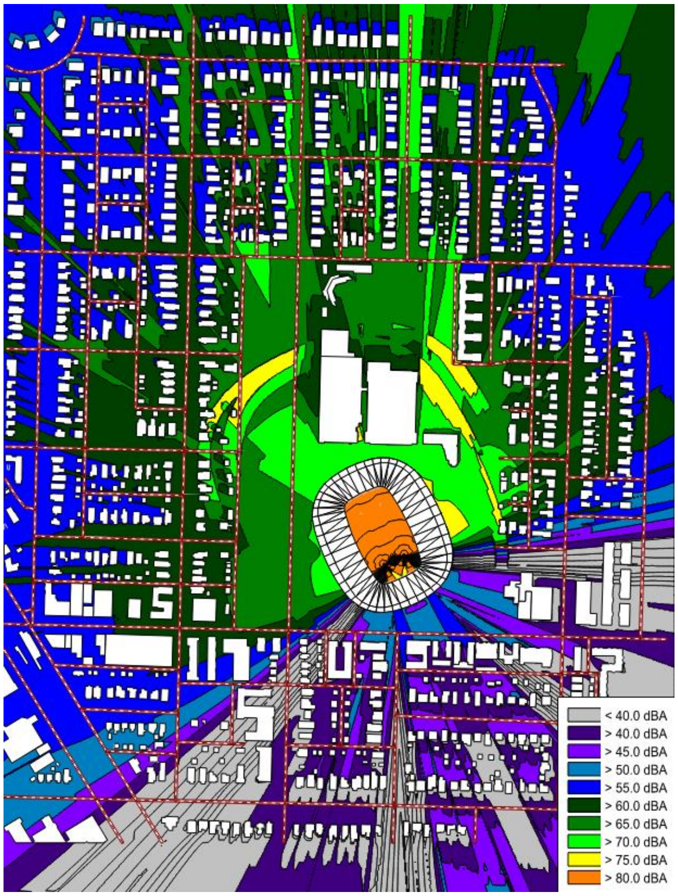
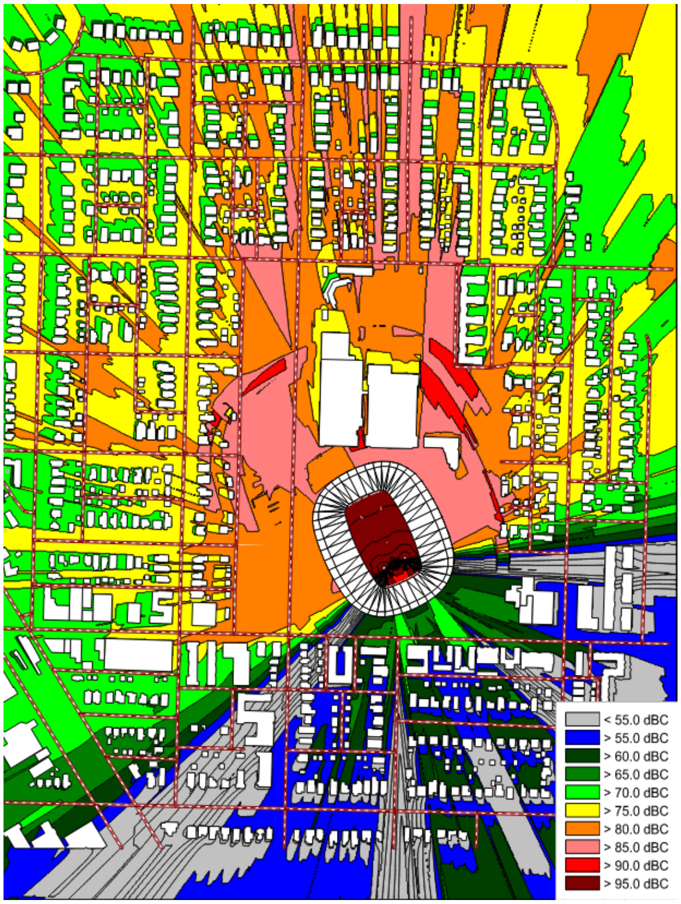


Figure 7: Concert Environmental Assessment Results with Additional Sound Mitigation (dBC)



With additional effective mitigations, there is a noticeable reduction in sound impact on the immediate West property line, and a noticeable reduction in sound impact to the Northwest. While sound will still be audible, projections generally fall in the 60 and 65 dBA ranges. There is a small sound shadow impact to the north that would positively impact a small number of residents. Again, this model does not account for the beneficial sound reduction impact that would be generated by the residential houses beyond the extent of the model.

Additional modeling is required to determine the exact extent of the barriers and the necessary sound reduction qualities of the materials installed, but our recommendation is that Northwestern consider including this mitigation in the project or have the opportunity to add them at a later time as an additional mechanism to mitigate environmental sound transmission.

Discussion and Comments

The site sound level measurements show the typical weekend ambient sound levels in the area surrounding Ryan Field are between 50-65 dBA (depending on proximity to the football stadium). This is a useful starting point for reviewing mitigation options in the stadium and the various uses. Based on these values, we think targeting a sound level of approximately 65 dBA at the residential properties would be appropriate to maintain current event sound level transmission to the neighborhoods. While not being inaudible, limiting the sound exposure at the surrounding community to these levels would be helpful by keeping the intruding sound from noticeably exceeding current ambient levels and not appreciably adding to the local ambient sound in the neighborhoods.

The current football operations exceed ambient community sound levels and may be used as a reference point for improvement targets associated with the new stadium design and uses. Concert sound levels with appropriate mitigation, as predicted in the CadnaA software and developed by Henderson Engineers, show sound levels peaking at 65-70 dBA. As noted above, while audible and higher than ambient noise, these levels are similar to the current football game activities.

It may be helpful to put some of these sound levels in perspective. Sound levels measured in the neighborhoods are similar to a busy open plan office (50 dBA) or moderately busy street/traffic (65 dBA). Other common sound sources with similar sound level include refrigerator (50 dBA), air conditioner (50-70 dBA), and normal conversation level (60-65 dBA). These are audible sound levels, but are not excessive for typical activities. It should also be noted that these predicted game day/concert sound levels are measured outdoors in open air, and interior sound would be mitigated by the structure of a home. Sound sources such as an ambulance (120 dBA), which is a common occurrence on Central street, are substantially louder than those sounds emitted from the stadium.

Per the United States Department of Housing and Urban Development (HUD), standard construction of any building type will result in an average reduction of sound levels by 20 dB inside the structure. Therefore, based on an anticipated 65-70 dBA at a residential structure on Maple Avenue as shown in Figure 6, the interior of the structure could expect a reduction of sound level to 45-50 dbA, which is comparable to refrigerator or washing machine operating.

We think the design of the new Ryan Field, and reduction in capacity of stadium, will be helpful in reducing sound impact when compared to the current stadium design. However, as with football game days, concerts will generate sound – there is no way to reduce it to zero. Northwestern and the City will need to work together to weigh the impact of sound generated by a limited number of concerts, versus the social and economic benefits of those same concerts. WJHW is not in a position to evaluate that decision. Our understanding is that there are already outdoor concerts occurring in Evanston in the same neighborhood, with no sound restrictions, and other local venues like Ravinia have managed to find a way to balance the sound generated by concerts with the benefits they derive.

However, there are some additional steps we think Northwestern could take to be cognizant of sound impacts and be a good partner with the residential community:

Limit concert sound levels

We recommend considering a limit on sound level produced by touring concerts within the stadium. Simply put, a quieter concert will result in a quieter neighborhood. We do not intend the limits set to be at such low volume that the enjoyment of the concert is compromised, nor to make the venue uncompetitive in a competitive market. Rather, the limit should be set to avoid specific bands/uses from excessively loud performances.

It may be difficult to determine an appropriate interior sound limit at this time without understanding exactly how concert sound escapes the stadium in real events. However, there are two options available to help determine potential limits a) model various concert setups in CadnaA (or similar, SoundPlan) to estimate a maximum sound level limit, and/or b) prior to the first event, set up a stage/speaker arrangement and test sound levels within the seating bowl with spot checks in the neighborhood for compliance. Both options may be necessary to finalize the preferred sound level limits.

It's also important to note that this is not a tool that creates certainty. But, it is a tool that venues across the country use and insert into contracts with artists. Northwestern could consider including a contractual penalty/fine for a performer who violates the mix-position sound limits.

Install sound monitoring devices in and/or around the stadium

Installing sound monitoring stations in the stadium seating bowl (typically at the mix position), on the stadium property, and/or within the residential communities allows real-time analysis of the sound levels generated by activities at the stadium. If located within the stadium, the monitoring equipment could help the facility staff quickly react to sound exceedances established for the event. If mounted outside the stadium, sound monitoring equipment could indicate if certain types of activities or acts are having a more significant impact on the community sound levels than others.

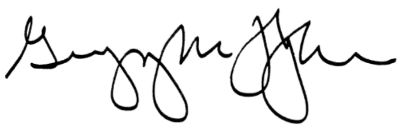
Limit concert times and days

Limiting concert times – particularly late evenings and weekdays – will reduce potential annoyance in the neighborhoods. It is often necessary to shut down concerts slightly earlier to reduce the potential of sleep interference in the community. This should be considered when developing activity schedules for the stadium.

The above recommended considerations may have an impact on sound reduction over a wide area or may be more targeted to specific complaints/issues that may arise. We recommend considering all or portion of the above mitigation options for a complete plan to mitigate sound transmission to the community.

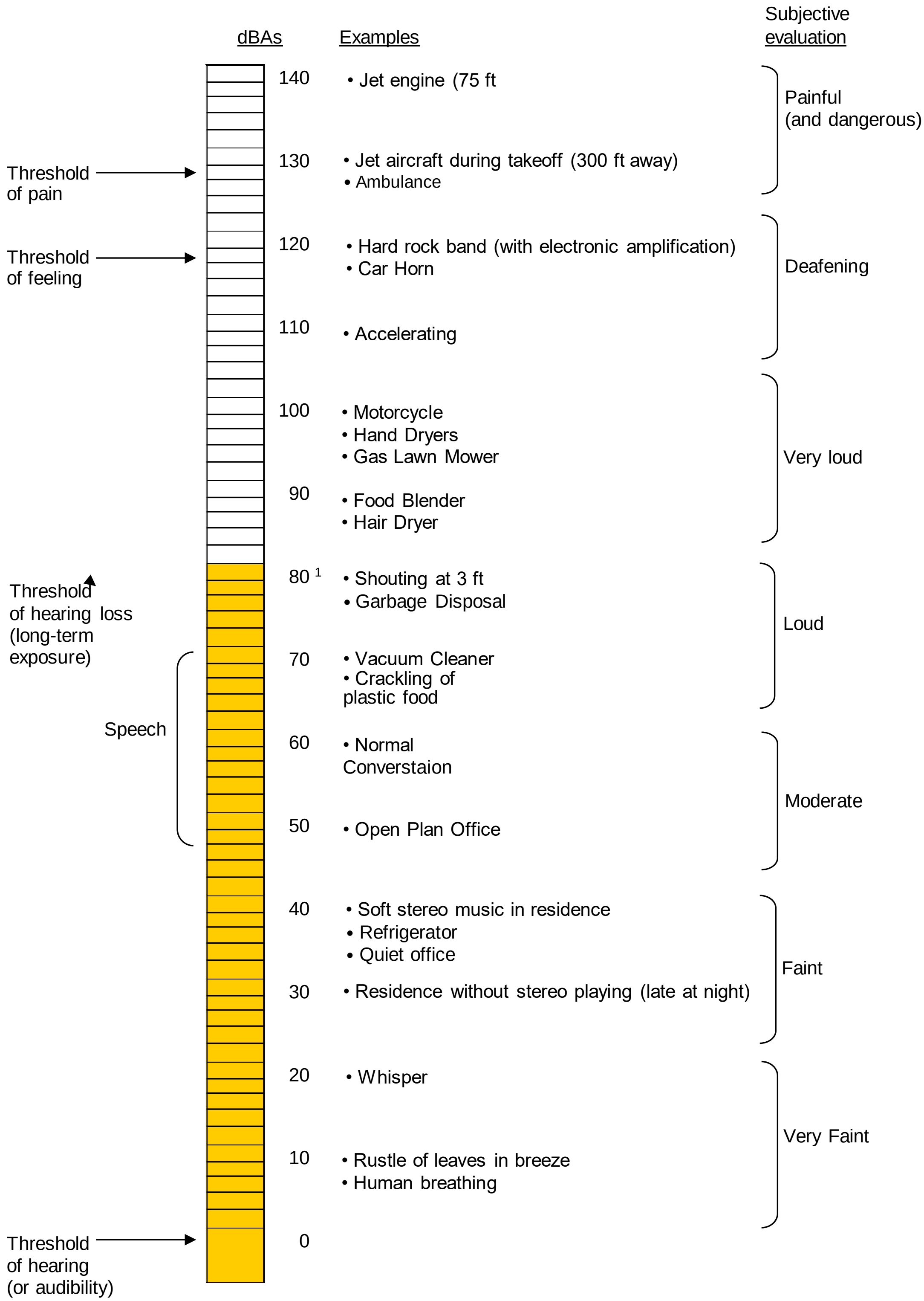
I trust this information to be helpful. Please let me know if you have questions.

Regards,



Greg Hughes
Principal

Appendix A: Reference Chart of Common Sounds in dBA



[1] Continuous exposure to sound energy above 80 dBA can be hazardous to health and can cause hearing loss for some persons.

Appendix B: Henderson Noise Survey

Exhibit - Noise Surveys

Two noise surveys were completed on separate occasions in order to assess the existing ambient noise levels during a gameday weekend and non-gameday weekend. The noise surveys were conducted with field calibrated Larson Davis Model 831 Type 1 sound level meters (SLM), each placed inside a weather-tight environmental enclosure. The microphone for each SLM was located in an environmental enclosure with a windscreen. The complete sound measuring apparatus was attached to an arm mount which was installed on a light pole or column along with the environmental kit approximately 10 – 12 feet above the ground.

1. Gameday Weekend

   An environmental noise survey was conducted for a continuous 67-hour period on October 7-10, 2022. See figures below for measurement locations.

Figure 1: Site Map of Measurement Location (Google Maps)

Figure 2: Measurement Equipment Photos

Below is a summary of the weather conditions during the measurement period.

Table 1: Weather Conditions (wunderground.com)

	Weather	Temperature (high / low)	Max Wind Speed
October 7, 2022	Fair	56° / 42°	17 mph
October 8, 2022	Fair	58° / 38°	17 mph
October 9, 2022	Fair	68° / 42°	12 mph
October 10, 2022	Fair	73° / 47°	13 mph

Overall, weather had negligible effects on the measurements.

The following table provides the overall measurement summary. See appendix for definitions.

Table 2: Overall Measurement Summary Results

	Date	Timeframe	L_{eq} "Average" (dBA)	$L_{max,slow}$ "Maximum" (dBA)	$L_{min,slow}$ "Minimum" (dBA)	L10 (dBA)	L90 (dBA)
Meter 1	10/7/2022	2pm - 12am	57.6	97.7	43.6	58.9	46.4
	10/8/2022	12am - 12am	71.8	90.0	42.5	77.4	44.4
	10/9/2022	12 am -12am	55.8	79.3	42.1	59.8	44.3
	10/10/2022	12am - 9am	55.4	85.2	35.8	55.6	44.3
Meter 2	10/7/2022	2pm - 12am	68.5	98.8	47.0	67.3	51.2
	10/8/2022	12am - 12am	71.4	99.1	46.5	76.7	47.4
	10/9/2022	12 am -12am	63.0	99.0	46.4	63.2	47.4
	10/10/2022	12am - 9am	60.2	88.9	40.0	63.8	47.9
Meter 3	10/7/2022	2pm - 12am	60.3	90.3	43.2	60.9	49.7
	10/8/2022	12am - 12am	74.2	89.4	42.2	79.8	44.5
	10/9/2022	12 am -12am	57.3	87.7	41.5	57.7	44.1
	10/10/2022	12am - 9am	58.7	91.3	41.8	60.0	43.0

A. Gameday Noise

1) There were tailgates/parties consisting of amplified music and large groups of people near the location of each sound level meter. The sound levels measured during the game in these locations is inflated when considering the sound level in the neighborhood during gamedays.

Figure 4: Tailgate/Party at South End of West Parking Lot
October 8, 2022

2) In addition to the long duration measurements, short duration sound measurements were collected in the surrounding neighborhood to determine the sound level at different locations around the site during the football game. The short duration measurements were collected with a Larson Davis Model 831 Type 1 sound level meter with windscreen and ranged in duration from 30 – 120 seconds. Refer to the following figure for short duration sound measurement locations.

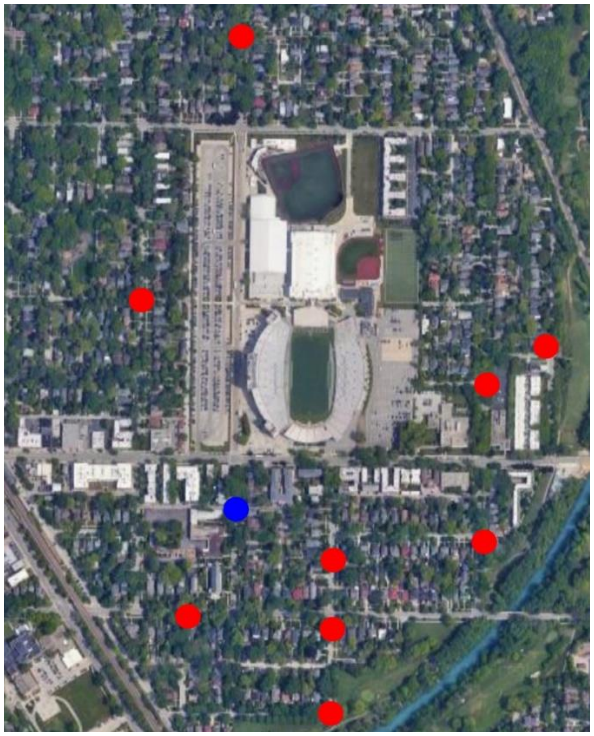


Figure 5: Short Duration Sound Measurement
Locations October 8, 2022

3) The LAeq sound levels ranged from 50-65 dBA for the locations shown in red. The LAeq sound level at the blue location was 84 dBA primarily due to the large party at the south end of west parking lot shown in Figure 4.

4) The primary noise source from the football stadium was the sound system, and it was audible at all of the short duration sound measurement locations. Since this is not a consistent noise source, it is not possible to isolate that sound from the other ambient noise such as cars, people, trains, and birds.

5) The main loudspeaker cluster is located at the north endzone and directed to the south. Based on subjective listening and sound levels measured, the sound levels are higher in the neighborhoods to the south than to the north from the stadium sound system. The sound levels from stadium sound system are higher in the neighborhoods to the east than to the west due to the east side of the stadium having a lower height since the pressbox is located on the west side.

2. Non-Gameday Weekend

An environmental noise survey was conducted for a continuous 57-hour period on December 2-4, 2022 during a non-gameday weekend. The sound level meter locations differed from the gameday noise survey, as they were placed in the surrounding neighborhoods. See figures below for measurement location.

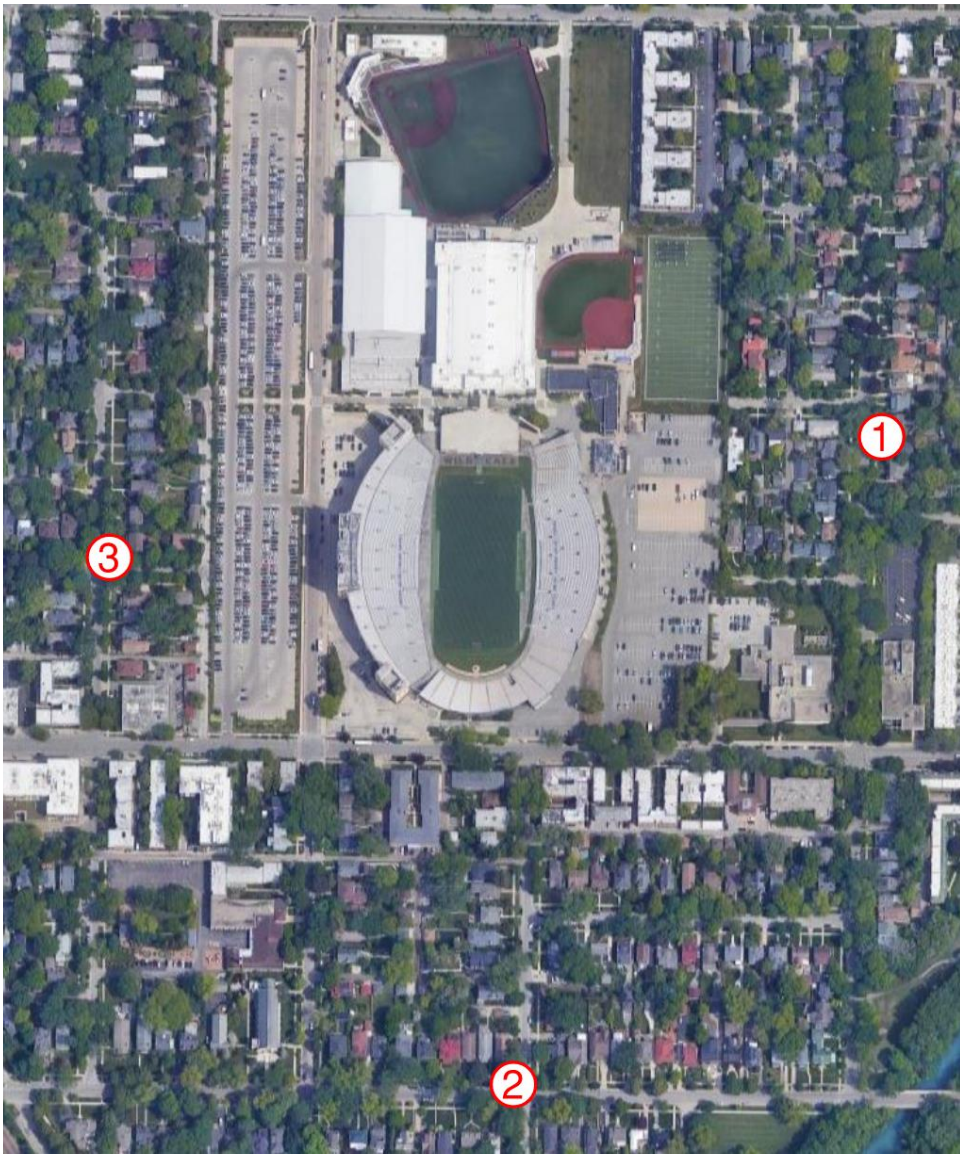


Figure 6: Site Map of Measurement Location (Google Maps)

Figure 7: Measurement Equipment Photos

Table 3: Sound Level Meter Locations

	Intersection	
Meter 1	Chancellor St.	Asbury Av.
Meter 2	Lincoln St.	Jackson Av.
Meter 3	Chancellor St.	Eastwood Av.

Below is a summary of the weather conditions during the measurement period.

Table 4: Weather Conditions (wunderground.com)

	Weather	Temperature (high / low)	Max Wind Speed
December 2, 2022	Fair	53° / 36°	23 mph
December 3, 2022	Fair	51° / 21°	26 mph
December 4, 2022	Early Morning Rain	40° / 19°	16 mph

Overall, weather had negligible effects on the measurements.

The following table provides the overall measurement summary. See appendix for definitions.

Table 5: Overall Measurement Summary Results

	Date	Timeframe	L_{eq} "Average" (dBA)	$L_{max,slow}$ "Maximum" (dBA)	$L_{min,slow}$ "Minimum" (dBA)	L10 (dBA)	L90 (dBA)
Meter 1	10/7/2022	2pm - 12am	57.6	97.7	43.6	58.9	46.4
	10/8/2022	12am - 12am	71.8	90.0	42.5	77.4	44.4
	10/9/2022	12 am -12am	55.8	79.3	42.1	59.8	44.3
	10/10/2022	12am - 9am	55.4	85.2	35.8	55.6	44.3
Meter 2	10/7/2022	2pm - 12am	68.5	98.8	47.0	67.3	51.2
	10/8/2022	12am - 12am	71.4	99.1	46.5	76.7	47.4
	10/9/2022	12 am -12am	63.0	99.0	46.4	63.2	47.4
	10/10/2022	12am - 9am	60.2	88.9	40.0	63.8	47.9
Meter 3	10/7/2022	2pm - 12am	60.3	90.3	43.2	60.9	49.7
	10/8/2022	12am - 12am	74.2	89.4	42.2	79.8	44.5
	10/9/2022	12 am -12am	57.3	87.7	41.5	57.7	44.1
	10/10/2022	12am - 9am	58.7	91.3	41.8	60.0	43.0

Appendix C: North Stage Analysis

Northwestern | FACILITIES

CAA ICON

MEMORANDUM

Date: August 7, 2023

Project: Ryan Field Redevelopment

To: Luke Figora (Northwestern University)

From: Dan Loosbrock (CAA ICON), Sarah Baresel (CAA ICON)

Subject: New Ryan Field – North Concert Stage Analysis

Due to the community inquiries regarding an alternative stage placement to the north, the analysis for a stage located in the north end zone was reassessed. This memo summarizes the key aspects, including acoustical considerations, infrastructure, safety and logistical efficiencies, which support the stage placement in the south endzone.

As indicated in the WJHW Environmental Assessment Review and Summary dated August 2, 2023, the alternative stage locations do not appear to be an attractive option for sound mitigation, given the sound reduction benefits of the building barrier effect related to Welsh-Ryan Arena and other existing Northwestern structures to the north of the stadium.

In addition to not having large building structures at the south end zone area to provide sound reduction benefits, the operational efficiencies which are necessary for concert operations become less efficient which would result in additional time for setup and dismantle of the concert stage and equipment.

The location of the loading dock and field access towards the north accommodate improved coordination of logistics allowing a stage setup to the south, and supplemental concert equipment throughout the field level. A concert stage setup at the north would create a restricted condition at the field access point, limiting the efficiency of the load-in and load-out procedures. Additionally, the location of the power source for the concerts was coordinated to be in close proximity to the main electrical room, as well as the south end student seating section, which allows the north end premium seating options to be utilized for concert events.

In conjunction with the operational efficiencies as noted above, effective crowd management is of utmost importance for the safety of the patrons as well as the venue staff and artist. Placement of the stage in the south endzone, along with the utilization of main patron access points at the north end of the stadium, establishes a controlled flow of foot traffic into the stadium moving towards the stage prior to the event, and then exiting away from the stage post event, keeping the venue entry controlled at the north end of the stadium, which will also minimize potential crowding along the pedestrian sidewalk areas along Central Street.