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# memorandum

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to Richard Rich, City of Sacramento; Jeffrey Dorso, Pioneer Law Group

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subject **Proposed Major League Soccer Stadium Noise Contours**

## 1.0 INTRODUCTION

Based on the most current available information, ESA developed noise contour maps for the proposed MLS Stadium within the Railyards Specific Plan Area (RSP Area). This technical memorandum describes the methodology used for the assessment and presents the results with noise contour maps. Three scenarios were assessed for this technical memorandum: 1) soccer game, 2) pre-game events at outside stages, and 3) music concert in the Stadium. The information in this memorandum updates and augments information provided in the Railyards DSEIR.

## 2.0 NOISE FUNDAMENTALS

Noise is generally defined as unwanted sound. Sound, traveling in the form of waves from a source, exerts a sound pressure level (referred to as sound level) that is measured in decibels (dB), which is the standard unit of sound amplitude measurement. The dB scale is a logarithmic scale that describes the physical intensity of the pressure vibrations that make up any sound, with 0 dB corresponding roughly to the threshold of human hearing and 120 to 140 dB corresponding to the threshold of pain. Pressure waves traveling through air exert a force registered by the human ear as sound.

Sound pressure fluctuations can be measured in units of hertz (Hz), which correspond to the frequency of a particular sound. Typically, sound does not consist of a single frequency, but rather a broad band of frequencies varying in levels of magnitude. When all the audible frequencies of a sound are measured, a sound spectrum is plotted consisting of a range of frequency spanning 20 to 20,000 Hz. The sound pressure level, therefore, constitutes the additive force exerted by a sound corresponding to the sound frequency/sound power level spectrum.

The typical human ear is not equally sensitive to all frequencies of the audible sound spectrum. As a consequence, when assessing potential noise impacts, sound is measured using an electronic filter that deemphasizes the frequencies below 1,000 Hz and above 5,000 Hz in a manner corresponding to the human ear's decreased sensitivity to extremely low and extremely high frequencies. This method of frequency weighting is referred to as A-weighting and is expressed in units of A-weighted decibels (dBA). A-weighting

follows an international standard methodology of frequency de-emphasis and is typically applied to community noise measurements.

An individual's noise exposure is a measure of noise over a period of time. While a noise level is a measure of noise at a given instant in time, community noise varies continuously over a period of time with respect to the contributing sound sources of the community noise environment. Community noise is primarily the product of many distant noise sources, which constitute a relatively stable background noise exposure, with the individual contributors unidentifiable. The background noise level changes throughout a typical day, but does so gradually, corresponding with the addition and subtraction of distant noise sources such as traffic. What makes community noise variable throughout a day, besides the slowly changing background noise, is the addition of short-duration, single-event noise sources (e.g., aircraft flyovers, motor vehicles, sirens), which are readily identifiable to the individual.

These successive additions of sound to the community noise environment change the community noise level from instant to instant, requiring the measurement of noise exposure over a period of time to accurately characterize a community noise environment and evaluate cumulative noise impacts. This time-varying characteristic of environmental noise is described using statistical noise descriptors. The most frequently used noise descriptors are summarized below:

$L_{eq}$: The $L_{eq}$, or equivalent sound level, is the energy-mean dBA during a measured time interval. It is the "equivalent" constant sound level that would have to be produced by a given source to equal the acoustic energy contained in the fluctuating sound level measured.

$L_{max}$: The maximum, instantaneous noise level experienced during a given period of time.

$L_{min}$: The minimum, instantaneous noise level experienced during a given period of time.

$L_{dn}$: Also termed the DNL, the $L_{dn}$ is defined as the A-weighted average sound level for a 24-hour day with a 10-dB penalty added to nighttime (10:00 p.m. to 7:00 a.m.) sound levels to compensate for people's increased sensitivity to noise during usually quieter evening and nighttime hours.

Noise levels from a particular source generally decline as distance to the receptor increases. Other factors, such as the weather, reflective surfaces, or barriers also help intensify or reduce the noise level at any given location. A commonly used rule of thumb for roadway noise is that for every doubling of distance from the source, the noise level is reduced by about 3 dBA at acoustically "hard" locations (i.e., the area between the noise source and the receptor is nearly complete asphalt, concrete, hard-packed soil, or other solid materials) and 4.5 dBA at acoustically "soft" locations (i.e., the area between the source and receptor is normal earth or has vegetation, including grass). Noise from stationary or point sources is reduced by about 6 to 7.5 dBA for every doubling of distance at acoustically hard and soft locations, respectively. Noise levels may also be reduced by intervening structures – generally, a single row of buildings between the receptor and the noise source reduces the noise level by about 5 dBA, while a solid wall or berm reduces noise levels by 5 to 10 dBA.

# 3.0 METHODOLOGY

This section describes methodologies used for this MLS Stadium noise impact assessment.

## 3.1 Noise Model

The Computer Aided Noise Abatement (CadnaA) noise propagation program (Version 4.6.155) was used to estimate the propagation of noise from the proposed MLS Stadium.

CadnaA is a Windows-based software program that predicts and assesses noise levels in the vicinity of noise sources based on International Organization for Standardization 9613-2 algorithms for noise propagation calculations. The calculations account for classical sound wave divergence plus attenuation factors resulting from air absorption, basic ground effects, and barrier/shielding.

## 3.2 Model Validation

The dominant noise sources from a soccer game include crowd shouting and public address announcement. In order to establish the noise sources in the model, noise measurement data collected from the soccer game between the Sacramento Republic Football Club (Sac Republic FC) and Colorado Rapids at Bonney Field on February 13, 2015 was used to validate the model.

Section 4.10 of the Draft Subsequent Environmental Impact Report (DSEIR) for the Railyards Specific Plan (RSP) Update stated that the noise level during the soccer game was 72.3 dBA $L_{eq}$ at 272 feet from the center of Bonney Field. Note that the noise level of 72.3 dBA $L_{eq}$ was based on 30-minute averages and included both crowd and public address system noise.

The model validation task is to develop the noise model to re-create the same measurement environment. The Bonney Field seating areas were used as the noise source, which generate noise level of 72.3 dBA at the actual measurement location. The result of the validated noise source was used for the proposed MLS Stadium noise model.

## 3.3 Assumptions

Several key assumptions were made for the model. Below describes each assumption.

- The proposed MLS Stadium capacity is 25,000 for a soccer game and 27,000 for a music concert.
- Three temporary stage locations within the plaza, but outside of the MLS Stadium, were evaluated. Each temporary stage would have amplified sound. Noise source levels at each of these stages were assumed to be 100 dBA at 5 feet, as described in Mitigation Measure 4.10-2(b) in Section 4.10 of the DSEIR.
- Music events within the MLS Stadium would take place on a stage at the southern end of the pitch. Noise source levels at this stage were assumed to be 98dBA at 150 feet, consistent with City Municipal Code section 8.68.160.
- Noise sources other than Stadium-related events were not considered for the noise contour development. Those potential noise sources would include rail, vehicular traffic, and KP Medical Center helicopter operations.
- Future structures within the RSP Area were included as “Built-Up Area” in the model using the following assumptions:
    - Lot 51a – Height would be 40 feet and 25% of the parcel would be developed.
    - Lot 51b – Height would be 30 feet and 50% of the parcel would be developed.

    - Lot 50 – Height would be 115 feet and 50% of the parcel would be developed.
    - Lot 49ab: Height would be 120 feet and 50% of the parcel would be developed.
    - Lot 69abcd – Height would be 125 feet and 50% of the parcel would be developed.
    - Lot 56abcd – Height would be 125 feet and 50% of the parcel would be developed.
    - Lot 70abd – Height would be 85 feet and 90% of the parcel would be developed.
    - Lot 57bcd – Height would be 155 feet and 90% of the parcel would be developed.
    - Lot 48ab – Height would be 205 feet and 50% of the parcel would be developed.
    - Lot 47ab – Height would be 85 feet and 50% of the parcel would be developed.
- Existing building footprints were obtained from Sacramento County GIS Data Library.
- Topographic data outside of the proposed MLS Stadium was obtained from USGS The National Map GIS Data.

This noise modeling accounts for the proposed design of the MLS Stadium including the structure height, building materials, locations of entries and exits, roof structure design, and site grading and topography. This analysis also takes into account the capacity of the stadium for all types of anticipated events, noise anticipated from those crowds, and specific locations of event stages. Further, the model inputs include details about the topography of the surrounding area, as well as surrounding existing and proposed building heights, locations, and site coverage.

# 4.0 FINDINGS

Figure 1 presents the noise contour map of a soccer game. Figure 2 presents the noise contour map of pre-game events outside of the Stadium from three stages operating concurrently. Figure 3 presents the noise contour map of a music concert with a stage inside the MLS Stadium. Noise contours down to 55 dBA $L_{eq}$ are presented, which is the threshold for the nighttime noise level as it is described in the City of Sacramento Noise Ordinance.

## 4.1 Soccer Game

As presented in Figure 1, the 60 dBA $L_{eq}$ noise contour ranges from less than 500 feet to approximately 1,500 feet from the center of the Stadium due to the intervening obstructions, such as buildings and topographic features. The areas most affected by soccer game noise would be areas within the RSP Area and areas to the north of the Stadium in the River District where there are large undeveloped areas and large spaces between existing buildings. Noise would also travel down unobstructed corridors such as along the existing railroad corridor south of the Stadium and streets that emanate from the Stadium into the surrounding neighborhood. Portions of the Alkali Flat neighborhood along 9$^{th}$ Street would be exposed to up to 60 dbA $L_{eq}$.

## 4.2 Pre-Game Events at Outdoor Stages

As presented in Figure 2, noise levels would be most acute at the areas right around the outdoor stages, with noise rippling mostly to the west. This is a result of the MLS Stadium providing a noise attenuation shield for areas to the east. As a result, the only area within the Alkali Flat area that would be exposed to 55 dBA $L_{eq}$ noise levels would be the KCRA employee parking lot.

Noise levels of 60 dBA $L_{eq}$ would extend approximately 1,000 feet to the west, north, and south. Noise levels of 55 dBA $L_{eq}$ would extend between 1,000 and 1,500 feet to the west, north, and south. The farthest 55 dBA $L_{eq}$ contour would stretch directly westward approximately 1,800 feet to between 5$^{th}$ Street and 6$^{th}$ Street.

## 4.3 Music Event

For a music event, the stage would be on the southern end of the Stadium pitch. Based on the building design, surrounding topography and existing buildings, areas in the Alkali Flat neighborhood could be affected. Noise levels up to 60 dBA $L_{eq}$ would be expected near the railroad tracks, near the Creamery and Globe Mills, along D Street eastward to 12th Street, along 11th Street southward to approximately F Street, and along 9th Street and 11th Street southward to F Street. Noise levels of 55 dBA $L_{eq}$ would be expected along C Street eastward to 15th Street; along 9th Street southward to nearly L Street; and in smaller pockets along 8th Street, 12th Street, and D Street. The 65 dBA $L_{eq}$ noise contour would extend south into the Alkali Flat neighborhood to approximately C Street, encapsulating the KCRA building and the Creamery.

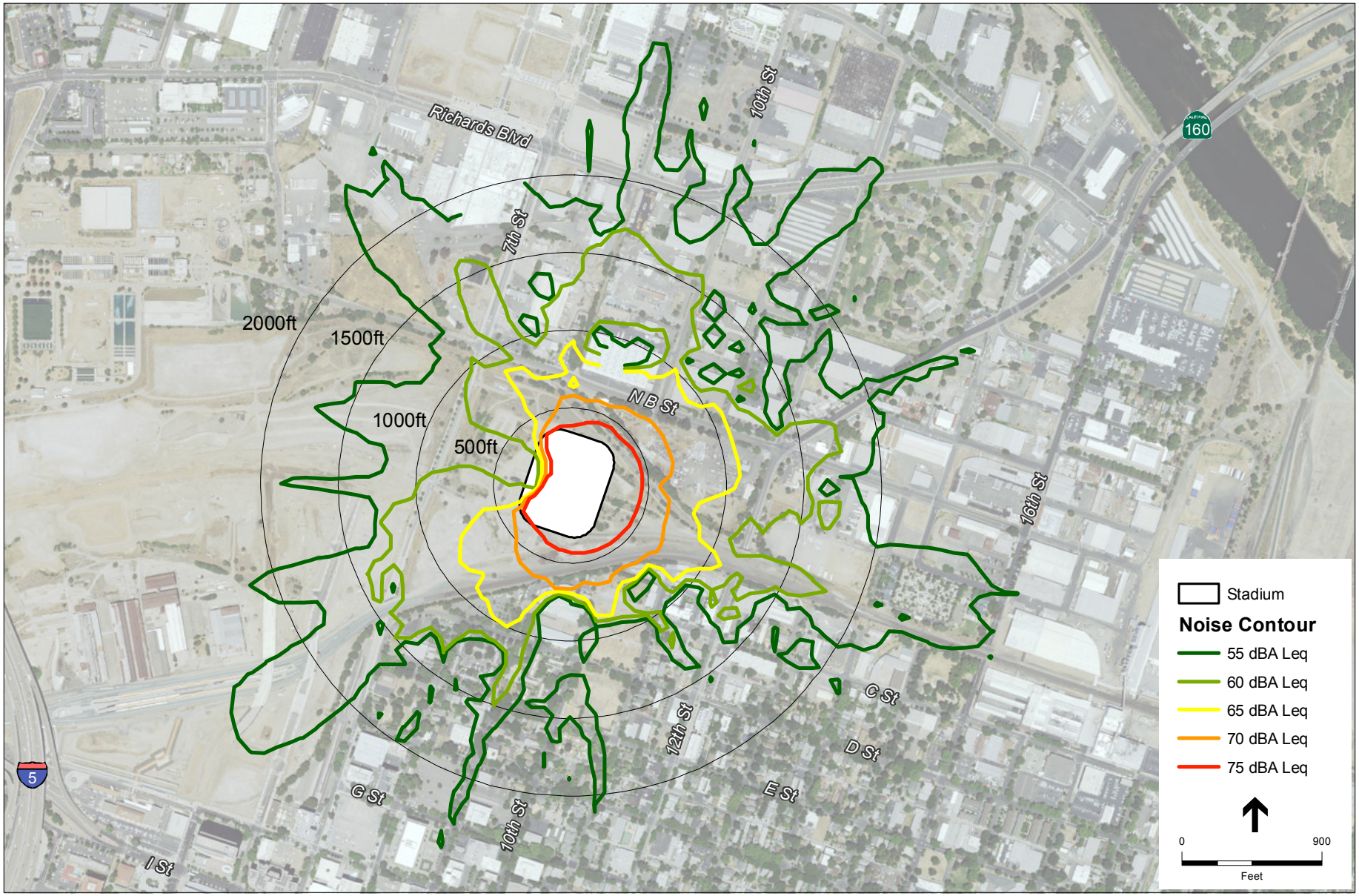
Noise would also extend westward across the RSP Area, with noise levels up to 75 dBA $L_{eq}$ expected southwest of the Stadium, potentially affecting Lots 47, 48, 49, and 51a. Noise contours would extend to the southwest, with the 70 dBA $L_{eq}$ contour line extending approximately 1,900 feet to nearly 5th Street, potentially affecting RSP Lots 3, 12, 17, 50, and 51b. The 70 dBA $L_{eq}$ contour would also extent northward approximately 1,800 feet to south of Richards Boulevard.

The 65 dBA $L_{eq}$ noise contour would extend to the southwest to approximately the Central Shops, where the existing buildings would provide further noise attenuation. This contour would also extend north well into the River District into some areas north of Richards Boulevard along 7th Street and 8th Street. The 60 dBA $L_{eq}$ noise contour would extend westward across much of the RSP Area, particularly along Railyards Boulevard and the existing railroad tracks. This contour would also extend to the north and northeast approximately 4,200 feet into the River District all the way to the American River and affecting the Dos Rios Housing Project.

The 55 dBA $L_{eq}$ noise contour would extend westward to the Sacramento River and potentially affecting portions of West Sacramento including River Walk and the Broderick neighborhood. This contour would also extend north and northwest into western areas of the River District, to the American River, and across the American River to Discovery Park.

## 4.4 Conclusions

Noise resulting from proposed events at the MLS Stadium would affect different areas of the surrounding parcels to varying degrees. Due to building design and other factors described above, areas to the southwest, west, and north of the MLS Stadium would be affected by amplified and crowd noise the most. Noise would travel along unobstructed corridors such as local roadways and between existing and proposed buildings, creating somewhat defined noise contours along those linear pathways. Sound from a music event inside the MLS Stadium would travel the farthest, followed by noise from a soccer game and noise from amplified noise at the outdoor stages.




SOURCE: Google, 2015; Kimley Horn, 2015; HNTB, 2016; ESA, 2016

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**Figure 1**

MLS Stadium - Soccer Game
Noise Contour Map


SOURCE: Google, 2015; Kimley Horn, 2015; HNTB, 2016; ESA, 2016

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**Figure 2**

MLS Stadium - Outside Stages
Noise Contour Map


SOURCE: Google, 2015; Kimley Horn, 2015; HNTB, 2016; ESA, 2016

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**Figure 3**

MLS Stadium - Music Concert
Noise Contour Map