Addendum No. 1 to an Environmental Impact Report

Introduction

Addendum No. 1 to the Environmental Impact Report for the Sycamore Canyon Business Park Buildings 1 and 2 Project (State Clearinghouse No. 2015081042; Project) has been prepared by the City of Riverside Planning Division ("City") in conformance with the California Environmental Quality Act (Public Resources Code, § 21000 et seq.) ("CEQA"), the *CEQA Guidelines* (Cal. Code Regulations, Title 14, Chapter 3 § 15000 et seq.) and the City of Riverside Resolution No. 21106 (Local CEQA Guidelines), to address minor changes to construction methodology of the Sycamore Canyon Business Park Buildings 1 and 2 (described below) to include limited blasting on portions of the Project site.

Section 15164(a) of the *CEQA Guidelines* states:

> *The lead agency or responsible agency shall prepare an addendum to a previously certified Environmental Impact Report (EIR) if some changes or additions are necessary but none of the conditions described in Section 15162 calling for preparation of a subsequent EIR have occurred.*

The purpose of Addendum No. 1 is to demonstrate that only minor changes have been made to the Project and to identify any applicable mitigation measures from the certified EIR as well as any additional or revised mitigation measure(s) necessary to reduce new potentially significant impacts, as clarified in this Addendum.

Background

The Project consists of the following Planning Cases P14-1072 (EIR), P14-1081 (DR), P14-1082 (MCUP), P16-0101 (GP), P16-0102 (PM), and P16-0103 (VR). The Environmental Impact Report for the Sycamore Canyon Business Park Buildings 1 and 2 (EIR) was certified and the Project approved by the City Council on February 14, 2017.

The approved Project consists of the development of two industrial warehouse buildings to be located approximately 0.4-mile west of Sycamore Canyon Boulevard at the western terminus of Dan Kipper Drive, north and west of Lance Drive. (Refer to **Figure 1 – Location Map**.) Building 1 will be a 1,012,995 square foot industrial distribution building and Building 2 will be a 362,174 square foot industrial building. (Refer to **Figure 2 – Site Plan**.) Mechanical grading, after issuance of a grading permit, was approved as part of the Project.

Summary of the Short-Term Project Construction Noise and Vibration Analysis in the EIR

Construction Noise

As part of the EIR noise analysis, a Noise Impact Analysis for the Project was prepared by Kunzman Associates dated August 1, 2016 (refer to Appendix I of the EIR). Project construction noise will result from the transport of workers, the movement of construction material to and from the Project site, ground clearing, excavation, grading,

and building activities. Project generated construction noise will vary depending on the construction process, type of equipment involved, location of the construction site with respect to sensitive receptors, the schedule proposed to carry out each task (e.g., hours and days of the week) and the duration of the construction work. Site preparation is expected to produce the highest sustained construction noise levels. (EIR, p. 5.12-21.) As stated in EIR Section 5.12.4, Project Design Features, "with regard to construction, any on-site rock crushing shall take place at the southeastern corner of the Project site and no blasting shall occur. (EIR, p. 5.12-19.)

Noise impacts projected onto adjacent properties from the Project are regulated by Sections 7.25.010 and 7.35.010 of the Riverside Municipal Code. These sections provide general regulations with regard to noise that is produced and projected onto surrounding land uses. These limits are applicable to noise generated as a result of the Project's temporary construction and ongoing operational activities.

The Noise Analysis in the EIR concluded that unmitigated noise levels may reach up to 80 A-weighted decibels (dBA) equivalent noise level (L_{eq}) at the nearest single-family detached residences north of the Project site during worst case construction noise scenario with no temporary barrier. The unmitigated noise levels would exceed the City's daytime exterior noise standard for residential property of 55 dBA. (EIR, p. 5.12-22.) Mitigation measure **MM NOI 1** requires the installation of a 12-foot high temporary noise barrier at the Project site's northern and western boundaries. With implementation of mitigation measure **MM NOI 1**, construction noise levels at residential property lines at the northern and western boundaries of the Project site will not exceed 75 dBA. (EIR, p. 5.12-45.) No barrier attenuation from the 12-foot high temporary noise barrier was factored in for the residences to the west since implementation of the 12-foot high temporary noise barrier will be located at the property line and at a lower elevation than the residences to the west, which are approximately 30 feet above the elevation of the Project site. Mitigation measures **MM NOI 2 through MM NOI 12** are also included which will yield up to an additional 10 dBA in noise reduction to minimize maximum noise events thereby further reducing construction noise. The EIR concluded that even with implementation of feasible mitigation measures, temporary impacts from construction noise on the adjacent residences will be **significant and unavoidable**. (EIR, p. 5.12-24.)

Short-term Construction Noise Mitigation Measures:

The EIR and Mitigation Monitoring and Reporting Program includes the following mitigation measures:

MM NOI 1: To reduce noise impacts to the surrounding residences and Sycamore Canyon Wilderness Park, prior to any Project-related construction or site preparation, a 12-foot temporary noise barrier shall be installed along the Project site's northern and western property line. The barrier shall be continuous without openings, holes or cracks and shall reach the ground. The barrier may be constructed with 1-inch plywood and provide a transmission loss of at least 23 dBA to ensure construction noise levels do not exceed 75 dBA at single-family residences located near the proposed Project. Other materials providing the same transmission loss shall also be permitted with the approval of the City Planning Division.

MM NOI 2: To attenuate initial impact noise generated when an excavator drops rock and debris into a truck bed, heavy grade rubber mats/pads shall be placed within the bed of the trucks. These mats shall be maintained and/or replaced as necessary.

MM NOI 3: During all Project-related excavation and grading, construction contractors shall equip all construction equipment, fixed and mobile, with properly operating and maintained mufflers, consistent with manufacturer standards.

MM NOI 4: All stationary construction equipment shall be located so that emitted noise is directed away from the residences to the north and west and from the Sycamore Canyon Wilderness Park to the west.

MM NOI 5: All construction equipment shall be shut off and not left to idle when not in use.

MM NOI 6: All equipment staging during all phases of construction shall be located in areas that will create the greatest distance between construction-related noise/vibration sources and the residences to the north and west and the Sycamore Canyon Wilderness Park to the west.

MM NOI 7: The use of amplified music or sound is prohibited on the Project site during construction.

MM NOI 8: Haul truck deliveries shall be limited to the same hours specified for construction equipment.

MM NOI 9: It is acknowledged that some soil compression may be necessary along the Project boundaries; however, the use of heavy equipment or vibratory rollers and soil compressors along the Project site's north and western boundaries shall be limited to the greatest degree feasible.

MM NOI 10: Jackhammers, pneumatic equipment, and all other portable stationary noise sources shall be shielded and noise shall be directed away from the residences to the north and west and Sycamore Canyon Wilderness Park to the west.

MM NOI 11: For the duration of construction activities, the construction manager shall serve as the contact person should noise levels become disruptive to local residents. A sign shall be posted at the Project site with the contact phone number.

MM NOI 12: No blasting shall take place on the Project site.

Vibration

The Federal Transit Administration (FTA) has published guidance in their document titled *Transit Noise and Vibration Impact Assessment*. According to the FTA, buildings can be exposed to ground-borne vibration levels of 0.5 inches per second peak particle velocity (PPV) without experiencing structure damage. Additionally, the FTA has determined that humans can experience vibration levels up to 80 vibration decibels (VdB) (RMS) before being adversely affected by vibration. (EIR, p. 5.12-37.)

As previously mentioned, sensitive receptors that may be affected by Project construction-related vibration include the existing residences to the north and west of the Project site. Ground-borne vibration attenuates quickly with distance and the PPV level from heavy equipment would be approximately 0.044 PPV at 40 feet. The majority of construction activity will be more than 40 feet from residences and would not be considered annoying. Additionally, the Project will comply with Section 7.35.010 of the Municipal Code, which prohibits construction, drilling, repair, alteration, grading, or demolition work that would result in sound creating a noise disturbance across a residential or commercial property line between the hours of 7:00 p.m. and 7:00 a.m. on weekdays, between 5:00 p.m. and 8:00 a.m. on Saturdays, and at any time on Sunday or a federal holiday. The Draft EIR concluded that potential impacts upon persons or structures due to construction-related vibration are **less than significant**. (EIR, pp. 5.12-37–5.12-38.)

Proposed Change in Construction Methodology

The Project Applicant plans to engage in additional meetings and coordination with residents to the north and west of the Project site regarding minor changes to the Project's approved construction methodology (i.e. mechanical grading) and mitigation measure **MM NOI 12**. In order to reduce the amount of time mechanical grading equipment will be in use in certain areas of the Project site, the Project Applicant is proposing blasting activities in the areas shown on **Figure 3 – Revised Blasting Activity Locations** during the grading phase of Project construction.

The Project Applicant is proposing blasts would occur at the edge of the blasting areas identified in **Figure 3 – Revised Blasting Activity Locations**. Based on information provided by the Project Applicant and blasting contractor (California Drilling and Blasting Co., Inc.), blasts will be below-ground and will be partially, if not substantially, contained, depending on the depth of the hard rock areas within the Project site. Blasting at the Project site is anticipated to occur during the grading stage of Project construction, which is estimated to last for roughly 60 days, with approximately seven to nine blasting events necessary to break the hard rock within the site. A blasting event is comprised of multiple charges that are set off at one time. Each blasting event is over within seconds and the events are spaced out over days to weeks apart. Alternative rock-breaking methods, if used, would be anticipated to result in a longer grading period of 122 days, with 47 days of rock-breaking activities including the use of excavators and impact hammer equipment. (Refer to Appendix A of this Addendum).

Blasting activities generally include the following: pre-drilling holes in the hard rock area; preparation and placement of the charges in the drilled holes; a pre-blast horn signal; additional pre-blast horn signals immediately prior to the blast; and the blast itself. An additional horn signal is sounded to indicate the "all clear" after the blast and blasting contractor has inspected the blasting area. The noise from the blast itself starts with a cracking sound from the detonator, located at a distance from the charges, and ends with the low crackling sound from each charge as they are subsequently set off. Blasts typically occur for only a few seconds (Refer to Appendix A of this Addendum).

Environmental Analysis of the Proposed Change in Construction Methodology

Because the proposed changes in construction methodology would take place on the same site, have the same proposed land uses, and have the same footprint, i.e., disturbance area, as the approved Project, with regards to: aesthetics, agriculture and forestry resources, air quality, biological resources, cultural resources, geology and soils, greenhouse gas emissions, hazards and hazardous materials, hydrology and water quality, land use and planning, mineral resources, long-term operational noise, population and housing, public services, recreation, transportation and traffic, tribal cultural resources and utilities and service systems would not change from what was evaluated in the certified EIR. Therefore, these impacts are not discussed further in this Addendum and this analysis focuses on short-term noise and short-term vibration impacts generated by proposed change in construction methodology (proposed blasting) at the Project site.

Short-Term Construction Noise and Short-Term Vibration

EIR Conclusion Regarding Construction Noise: Significant and Unavoidable Impact.

EIR Conclusion Regarding Vibration: Less than Significant Impact.

Proposed Change in Construction Methodology: No New Impacts to Construction Noise or Vibration.

In order to evaluate the proposed noise impacts related to short-term blasting, a Blasting Air Overpressure and Vibration Impact Assessment Letter (Assessment Letter) was prepared by Urban Crossroads dated December 7, 2017 (Refer to Appendix A of this Addendum). The Assessment Letter was prepared consistent with the 18th Edition of the *International Society of Explosives Engineer's (ISEE's) Blasters' Handbook* (Blasters' Handbook). Based on Table 26.17 *Typical Air Overpressure Damage Criteria* of the Blaster's Handbook, an air overpressure of 133 dB is identified as a perception-based criteria level for blasting. As such, the Assessment Letter evaluates the Revised Project's blasting-related vibration and airblast levels based on the construction noise and vibration levels previously identified in the Draft EIR and to the 133 dB criteria for airblast identified by the ISEE and U.S. Bureau of Mines. The proposed blasting area is included in this Addendum as **Figure 3 – Revised Blasting Activity Locations**.

As with mechanical grading, blasting will result in short-term noise and vibration impacts during grading of the Project site. These construction-related impacts will be temporary and will cease when the grading phase of construction is complete.

As required by EIR mitigation measure **MM NOI 1**, Project construction noise levels must satisfy a 75 dBA L_{eq} construction noise mitigation with the installation of a temporary 12-foot high noise barrier. For comparison with the previously-identified construction noise level, the proposed blasting activities were compared to the 75 dBA L_{eq} threshold.

The closest residences from the proposed blasting activities are located approximately 100 feet to the north and approximately 230 feet to the west. **Table 1 – Airblast Levels** presents the calculated airblast levels from the worst case (closest) Project blasting activities. As shown in **Table 1**, airblast levels are expected to range from 115 dB to 126 dB, which are below the 133 dB airblast threshold identified in the ISEE's Blasters' Handbook and U.S. Bureau of Mines standards.

Table 1 – Airblast Levels

Blasting Location[1]	Worst-Case Distance to Blasting	Blasting Levels[1] Airblast (dB)	Threshold[2] Airblast (dB)	Threshold Exceeded?[3] Airblast (dB)
North Area	100 feet	126	133	No
West Area	230 feet	115	133	No

Source: Urban Crossroads. 2017. Sycamore Canyon Blasting Air Overpressure and Vibration Impact Assessment Letter (Assessment Letter) (Appendix A to this Addendum)

Notes:

[1] Based on input data provided by California Drilling & Blasting. Calculations are provided in Appendix A of the Assessment Letter.

[2] Airblast threshold is based on ISEE's Blasters' Handbook, Table 26.17 Typical Air Overpressure Damage Criteria, and U.S. Bureau of Mines standards.

[3] Do the blast-related vibration and airblast levels exceed the thresholds?

dB = decibels

For a comparison with the EIR noise analysis, the linear airblast levels were converted to A-weighted hourly (L_{eq}) noise levels.[1] The analysis assumes that blasts will occur for up to three seconds. Assuming no other construction equipment are operating during blasting activities, the one-minute L_{eq} blasting noise level is combined with the typical residential ambient noise level, as measured at locations LT1 and LT2 as shown on EIR **Figure 5.12-1 – Noise Measurement Locations**, at 54.0 dBA L_{eq} and 46.3 dBA L_{eq}, respectively, for the remaining 59 minutes of the hour. **Table 2 – Unmitigated Blasting Noise Level Summary** presents the unmitigated airblast levels by noise level descriptor, which does not include additional attenuation due to intervening structures in the Project study area (berms, barriers, buildings, slopes, etc.). As shown on **Table 2**, the unmitigated airblasts are expected to result in hourly construction noise levels ranging from 80.8 dBA L_{eq} to 91.6 dBA L_{eq} at the residences to the west and north, respectively.

Table 2 – Unmitigated Blasting Noise Level Summary

Blasting Location[1]	Worst-Case Distance to Blasting	Unmitigated Blasting Levels	
		Airblast Levels (dB)	One-Hour dBA L_{eq}
North Area	100 feet	126	91.6
West Area	230 feet	115	80.8

Source: Urban Crossroads. 2017. Sycamore Canyon Blasting Air Overpressure and Vibration Impact Assessment Letter (Assessment Letter) (Appendix A to this Addendum)

Notes:

Worst-case blasting levels do not include any additional attenuation due to intervening structures or topographic changes in the Project study area (berms, barriers, slopes, etc.)

dB = decibels; dBA = A-weighted decibels; L_{eq} = equivalent noise levels

Table 3 – Noise Level Compliance for Blasting Activities shows the mitigated hourly dBA L_{eq} noise levels which include implementation of EIR mitigation measure **MM NOI 1**, which reduces noise levels by approximately 17.1 dBA L_{eq} for the residences to the north. No barrier attenuation from the 12-foot high temporary noise barrier is included in the calculation for the residences to the west since implementation of the 12-foot high temporary noise barrier (**MM NOI 1**) will be located at the property line and at a lower elevation than the residences to the west, which are approximately 30 feet above the elevation of the Project site. For the residences to the west of the Project site, noise attenuation of 7.4 dBA L_{eq} is provided by the topographic difference and existing earthen berm. As shown on **Table 3**, the hourly blasting noise levels are expected to range from 73.4 dBA L_{eq} to 74.5 dBA L_{eq} which is below the 75 dBA L_{eq} construction noise level threshold identified in Mitigation Measure **MM NOI 1**.

[1] Refer to pages 7 and 8 of Appendix A to this Addendum for a discussion regarding the conversion of linear airblast levels to A-weighted hourly (L_{eq}) noise levels.

Table 3 –Noise Level Compliance for Blasting Activities

Blasting Location[1]	Unmitigated Blasting Noise Levels (dBA L_{eq})	Barrier/Berm Attenuation (dBA L_{eq})[1]	Blasting Noise Levels with Barrier/Berm Attenuation (dBA L_{eq})[2]	Threshold (dBA L_{eq})[2]	Threshold Exceeded?[3]
North Area	91.6	-17.1	74.5	75	No
West Area	80.8	-7.4	73.4	75	No

Source: Urban Crossroads. 2017. Sycamore Canyon Blasting Air Overpressure and Vibration Impact Assessment Letter (Assessment Letter) (Appendix A to this Addendum)

Notes:

[1] Calculated barrier and berm attenuation are provided in Appendix C of the Assessment Letter.

[2] Based on the previously identified construction noise level of 75 dBA L_{eq} with the 12-foot high temporary noise barrier as identified in **MM NOI** 1 of the Draft EIR.

[3] Do the Project blasting noise levels exceed the previous Draft EIR construction noise levels?

dBA = A-weighted decibels; L_{eq} = equivalent noise levels

As with the mechanical grading, blasting will result in short-term vibration impacts from the use of construction equipment and blasting. However, this impact will be temporary and will cease when construction is complete. The Project's construction vibration threshold is 0.5 inches per second PPV. For comparison with the construction vibration level identified in the EIR, blasting activities was compared to the 0.5 inches per second PPV.

Table 4 – Blasting Vibration Levels shows the calculated vibration levels for the worst-case (closest) blast locations near the adjacent residences north and west of the Project site.

Table 4 –Blasting Vibration Levels

Blasting Location[1]	Worst-Case Distance to Blasting	Blasting Levels[1] Vibration (PPV)	Threshold[2] Vibration (PPV)	Threshold Exceeded?[3] Vibration (PPV)
North Area	100 feet	0.37	0.5	No
West Area	230 feet	0.35	0.5	No

Source: Urban Crossroads. 2017. Sycamore Canyon Blasting Air Overpressure and Vibration Impact Assessment Letter (Assessment Letter) (Appendix A to this Addendum)

Notes:

[1] Based on input data provided by California Drilling & Blasting. Calculations are provided in Appendix A of the Assessment Letter.

[2] Vibration threshold obtained from the City of Riverside Sycamore Canyon Business Park Buildings 1 and 2 Draft Environmental Impact Report, Page 5.12-37.

[3] Do the blast-related vibration and airblast levels exceed the thresholds?

The vibration levels of the Revised Project's blasts are expected to range from 0.35 to 0.37 inches per second PPV which is below the FTA threshold of 0.5 inches per second PPV. Additionally, the Revised Project will comply with Sections 7.25.010 and 7.35.010 of the Riverside Municipal Code. Therefore, the Revised Project will not result in new or more severe impacts than those already disclosed in the certified EIR for the Original Project.

Based on the above analysis and the analysis in Appendix A, blasting activities will not generate construction noise levels above what was previously analyzed in the EIR. Additionally, any blasting activities will still comply with Sections 7.25.010 and 7.35.010 of the Riverside Municipal Code. During Project construction, mitigation measure **MM NOI 12** as revised and clarified below shall be implemented. Deletions are shown with a strikethrough text (~~example text~~) and additions are shown with double underline text (example text).

> **MM NOI 12:** During grading activities, ~~No~~ no blasting shall take place on the Project site except for the areas depicted in Figure 3 of Addendum No. 1 to the Environmental Impact Report for the Sycamore Canyon Business Park Buildings 1 and 2 Project. No other construction equipment shall operate during each blast in the blast area, but can commence operation once the blasting contractor indicates it is safe to do so.
>
> All blasting activities must satisfy all applicable federal, state, and local rules and regulations including but not limited to the *International Society of Explosives Engineer's Blasters' Handbook*, Federal Transit Administration (FTA) (e.g., blasting vibration level shall not exceed FTA's threshold of 0.5 inches per second peak particle velocity (PPV)). Written notification shall be provided to all property owners within 1,000 feet of the blasting location no later than 14 days prior to the first blasting event. Such notification shall include the approximate dates of when blasting is scheduled to occur.

The above revision to mitigation measure **MM NOI 12** shall supersede mitigation measure **MM NOI 12** in the EIR and Mitigation Monitoring and Reporting Program. Additionally, in accordance with Title 17, the Project Applicant shall obtain a permit from the Fire Chief and the conditions contained in the grading permit shall become conditions of the excavation blasting permit. The below revisions are made to EIR Section 5.8, Hazards and Hazardous Materials. (EIR, p. 5.8-14.) Deletions are shown with a strikethrough text (~~example text~~) and additions are shown with double underline text (example text).

> With regard to blasting, Title 17 states that no person shall do any excavation blasting without a permit from the Fire Chief, and the conditions contained in the grading permit shall become conditions of the excavation blasting permit. Mitigation measure **MM NOI 12** has been revised to allow blasting activities during construction in the areas as depicted in **Figure 3 – Revised Blasting Activity Locations**, ~~of this~~ ~~Addendum~~. ~~Because the rocks present on the Project site may be removed using conventional methods, blasting is not an option and is not permitted per~~ measure **MM NOI 12**.

Therefore, the Revised Project's clarification to Section 5.12.4, Project Design Features, in the Noise Section to allow blasting in areas identified in **Figure 3 – Revised Blasting Activity Locations**; the clarification to Mitigation Measure **MM NOI 12** to allow blasting in areas identified in **Figure 3 – Revised Blasting Activity Locations**; and the requirement that the Project Applicant obtain a permit from the Fire Chief for blasting activities as mentioned in the Hazards and Hazardous Materials section of the EIR will not result in new or more severe impacts than those already disclosed in the certified EIR.

Conclusion

With implementation of the revised text as it relates to blasting activities in the Hazards and Hazardous Materials Section, Noise Section, and mitigation measure **MM NOI 12** as clarified above, the change in construction

methodology will not result in any new significant environmental effects or a substantial increase in the severity of previously identified significant impacts; therefore a subsequent, or supplemental EIR is not required.

Findings

Section 15164(a) of the *CEQA Guidelines* states:

> *The lead agency or responsible agency shall prepare an addendum to a previously certified Environmental Impact Report (EIR) if some changes or additions are necessary but none of the conditions described in Section 15162 calling for preparation of a subsequent EIR have occurred.*

The following table presents a summary of the Revised Project's consistency with each condition in Section 15162 on the following page.

Table 1 – Section 15162 Conditions and Findings

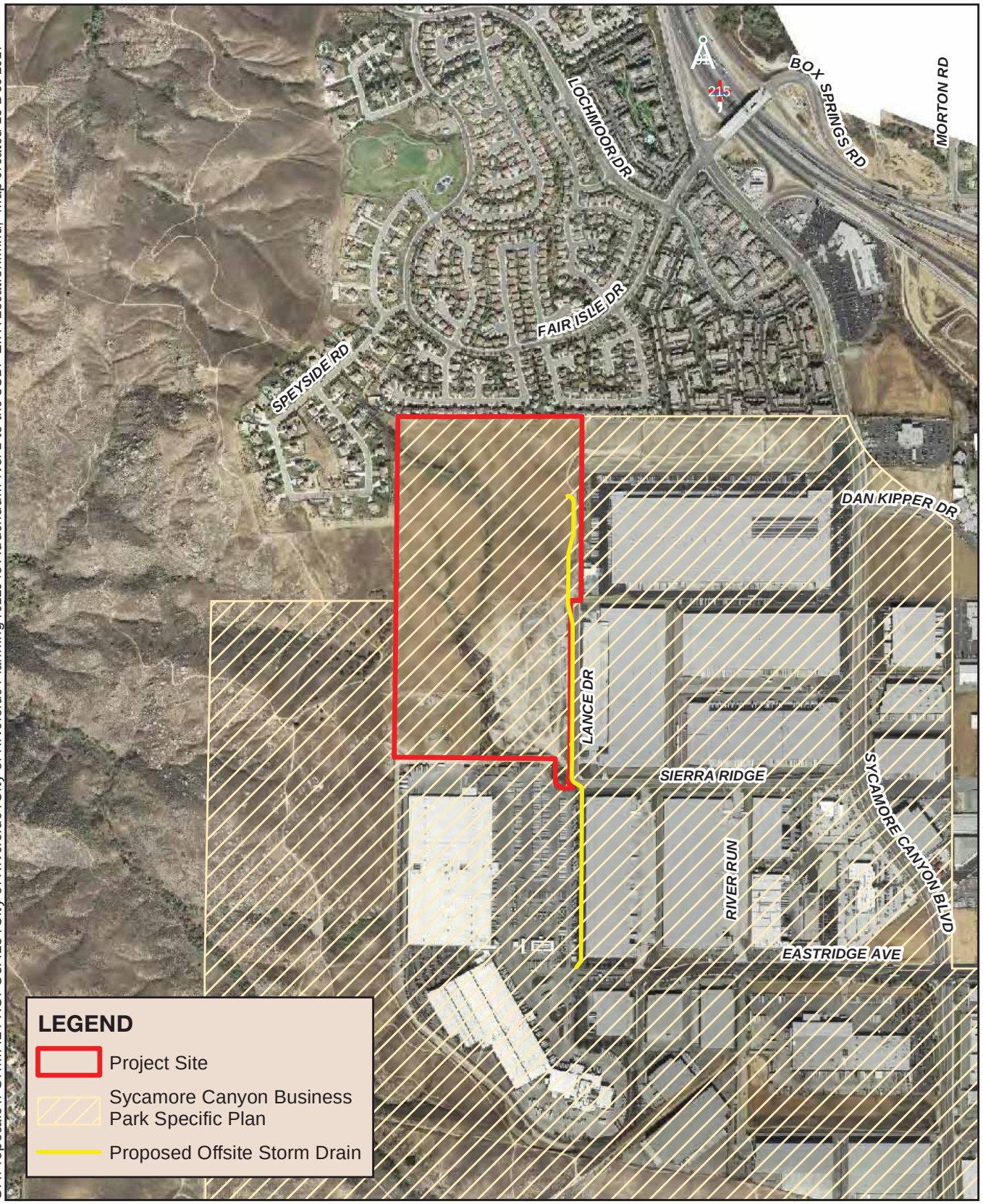
Section 15162 Condition	Revised Project Consistency
(1) Substantial changes are proposed in the project which will require major revisions of the previous EIR or negative declaration due to the involvement of new, significant environmental effects or a substantial increase in the severity of previously identified significant effects;	The Revised Project proposes blasting activities in areas as identified in **Figure 3** – **Revised Blasting Activity Locations**, of this Addendum. The preceding analysis and revisions to the Hazards and Hazardous Materials Section, Noise Section, and EIR mitigation measure **MM NOI 12** shows that these changes constitute a minor revision to the Project that does not involve new significant environmental effects or any increase in the severity of previous environmental effects.
(2) Substantial changes occur with respect to the circumstances under which the project is undertaken which will require major revisions of the previous EIR or Negative Declaration due to the involvement of new significant environmental effects or a substantial increase in the severity of previously identified significant effects; or	The minor changes to allow short-term blasting activities during Project construction will not result in new significant environmental effects or increase the severity of previously identified significant effects as demonstrated in the preceding analysis.
(3) New information of substantial importance, which was not known and could not have been known with the exercise of reasonable diligence at the time the previous EIR was certified as complete or the Negative Declaration was adopted, shows any of the following:	There is no new information of substantial importance.

Section 15162 Condition	Revised Project Consistency
(A) The project will have one or more significant effects not discussed in the previous EIR or negative declaration;	As shown in the preceding analysis, no new impacts will occur as a result of the change in construction methodology to allow blasting.
(B) Significant effects previously examined will be substantially more severe than shown in the previous EIR	As shown in the preceding analysis, no new impacts will occur as a result of implementation of the change in construction methodology.
(C) Mitigation measures or alternatives previously found not to be feasible would in fact be feasible, and would substantially reduce one or more significant effects of the project, but the project proponents decline to adopt the mitigation measure or alternative; or	All potentially significant impacts related to construction noise were determined to be significant and unavoidable even with the incorporation of mitigation measures **MM NOI 1 through MM NOI 12** and potential significant impacts related to construction vibration were determined to be less than significant. Minor revisions to mitigation measure **MM NOI 12** to allow for blasting activities in areas identified in **Figure 3 – Revised Blasting Activity Locations**, of this Addendum does not change the significance conclusion for construction and vibration noise determined in the certified EIR. Thus, the change in construction methodology will not result in any new impacts that were not evaluated in the EIR.
(D) Mitigation measures or alternatives that are considerably different from those analyzed in the previous EIR would substantially reduce one or more significant effects on the environment, but the project proponents decline to adopt the mitigation measure or alternative.	All potentially significant impacts related to construction noise were determined to be significant and unavoidable even with the incorporation of mitigation measures **MM NOI 1 through MM NOI 12** and potential significant impacts related to construction vibration were determined to be less than significant. Minor revisions to mitigation measure **MM NOI 12** to allow for blasting activities in areas identified in **Figure 3 – Revised Blasting Activity Locations**, of this Addendum does not change the significance conclusion for construction and vibration noise determined in the certified EIR. Thus, the change in construction methodology will not result in any new impacts that were not evaluated in the EIR. No new mitigation measures are needed.

The City of Riverside has reviewed the proposed changes in construction methodology in light of the requirements defined under the *CEQA Guidelines* and determined that none of the above conditions requiring preparation of a subsequent or supplemental EIR apply.

Figures

Figures referenced in this Addendum are included on the following pages.



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Sources: Thienes Engineering, Aug. 2015; Riverside County, 2017; City of Riverside, 2012.

0 500 1,000 1,500 Feet

Figure 1 - Location Map

Sycamore Canyon Business Park Buildings 1 and 2
EIR Addendum No. 1

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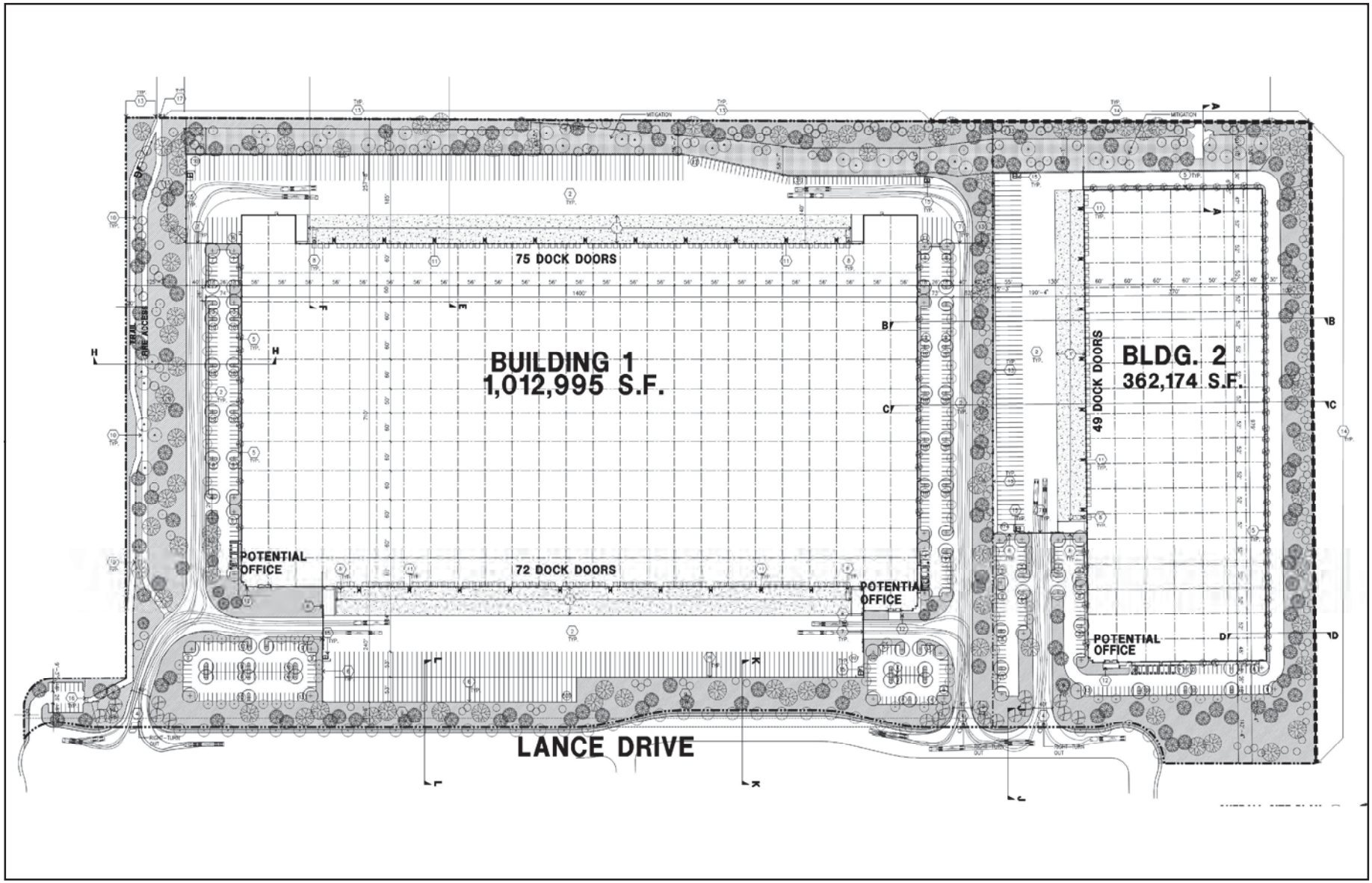
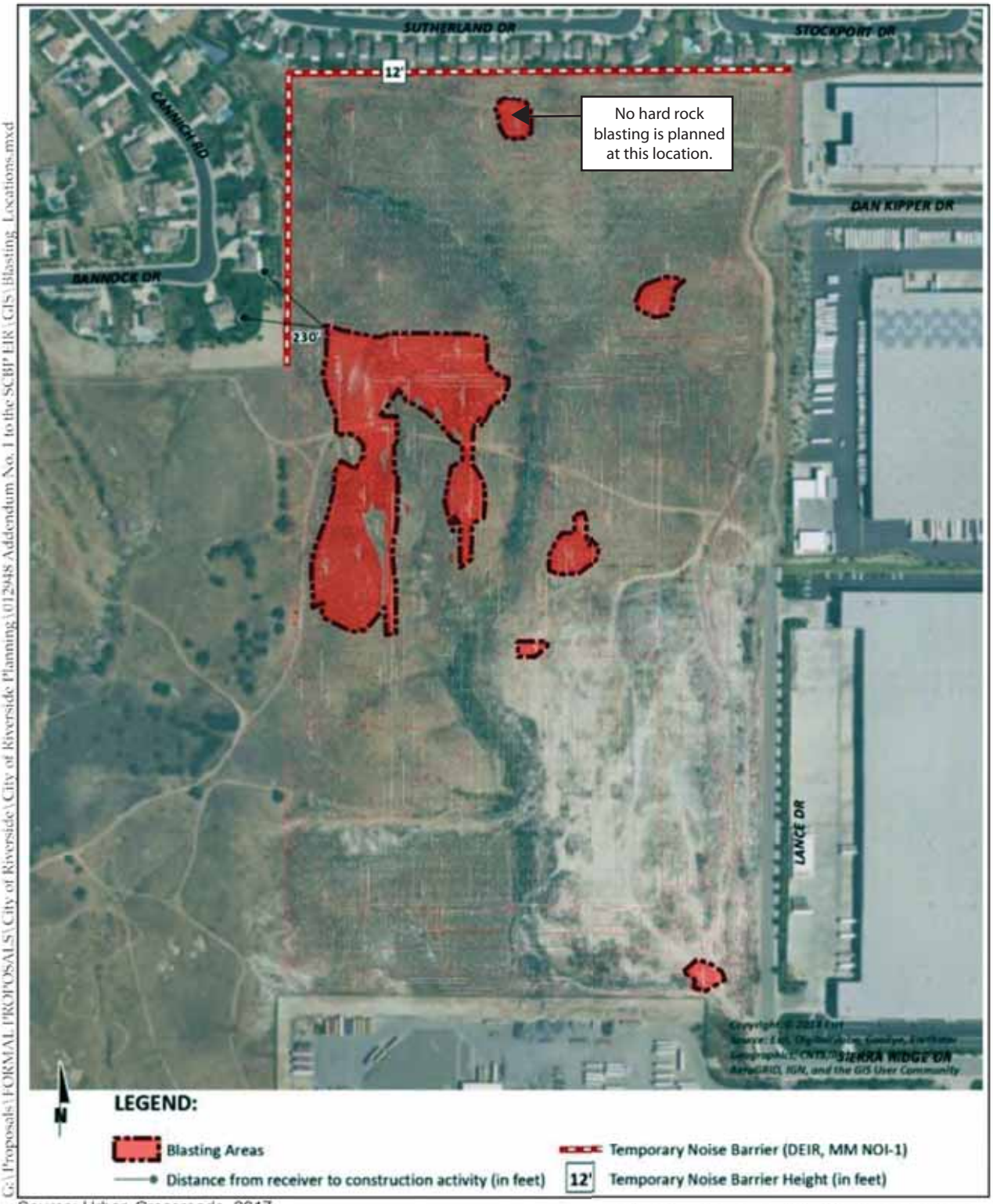


Source: HPA Architecture, July 2016.

Figure 2 - Proposed Site Plan
Sycamore Canyon Business Park Buildings 1 and 2
EIR Addendum No. 1

Not to Scale

ALBERT A. WEBB ASSOCIATES



Source: Urban Crossroads, 2017.

Figure 3 - Revised Blasting Activity Locations

Sycamore Canyon Business Park Buildings 1 and 2
EIR Addendum No. 1

Not to Scale

ALBERT A. WEBB ASSOCIATES

Appendix A

Blasting Air Overpressure and Vibration Impact Assessment Letter

URBAN CROSSROADS

260 E. Baker St. | Suite 200 | Costa Mesa, CA 92626 | (949) 660-1994
urbanxroads.com

December 7, 2017

Ms. Kathy Hoffer
Hillwood
2855 Michelle Dr., Suite 180
Irvine, CA 92606

SUBJECT: SYCAMORE CANYON BLASTING AIR OVERPRESSURE AND VIBRATION IMPACT ASSESSMENT LETTER

Dear Ms. Kathy Hoffer:

Urban Crossroads, Inc. is pleased to provide the following Blasting Air Overpressure and Vibration Impact Assessment Letter for the Sycamore Canyon ("Project"), which is located at the western terminus of Dan Kipper Drive, north and west of Lance Drive in the City of Riverside. The purpose of this Blasting Air Overpressure and Vibration Impact Assessment Letter is to evaluate the potential impacts due to blasting during Project construction activity at nearby residential homes north and west of the Project site. In addition, this letter provides a comparison with the construction impacts previously identified in the *Sycamore Canyon Business Park Buildings 1 and 2 Draft Environmental Impact Report* ("DEIR"). (1) This letter has been prepared consistent with the 18th Edition of the *International Society of Explosives Engineer's (ISEE's) Blasters' Handbook* ("Blasters' Handbook"). (2)

PREVIOUS DEIR FINDINGS

The DEIR previously analyzed Project construction noise levels and found them to result in *significant and unavoidable* impacts, with unmitigated hourly construction noise levels of up to 80 dBA L_{eq}. (1) To reduce the Project's temporary construction noise levels, mitigation measures (MMs) NOI-1 to NOI-12 were identified. MM NOI-1 of the DEIR requires that Project construction noise levels remain below a noise mitigation threshold of 75 dBA L_{eq} as a result of the installation of a 12-foot high temporary noise barrier at the Project's northern and western site boundaries adjacent to residential uses. Therefore, with the construction of the temporary 12-foot high noise barrier, the Project construction noise levels, per the DEIR, must satisfy a 75 dBA L_{eq} construction noise mitigation threshold.

Since blasting-generated air overpressure levels ("airblasts") will result in potentially perceptible noise levels at nearby residential homes, this letter analyzes the resulting noise levels due to Project airblasts for comparison with the previously-identified construction noise levels in the DEIR, and the DEIR MM NOI-1 75 dBA L_{eq} construction noise mitigation threshold.

In addition to Project construction noise levels, the DEIR identified *less than significant* construction vibration impacts based on the Federal Transit Administration threshold of 0.5 inches per second (in/sec)

peak-particle-velocity (PPV). Therefore, this letter uses the same threshold to evaluate potential blasting-related vibration levels experienced at the nearby residential homes.

BLASTING AIR OVERPRESSURE STANDARDS

In addition to the previously identified thresholds and construction noise levels disclosed in the DEIR, air overpressure regulations are identified by the U.S. Bureau of Mines and the ISEE's Blasters' Handbook. (2) Based on Table 26.17 *Typical Air Overpressure Damage Criteria* of the Blasters' Handbook, an air overpressure of 133 dB is identified as a perception-based criteria level for blasting. As such, to present a conservative approach, this letter evaluates the Project blasting-related vibration and airblast levels based on the construction noise and vibration levels previously identified in the DEIR, in addition to the 133 dB criteria for airblasts identified by the ISEE and U.S. Bureau of Mines.

PROJECT BLASTING ACTIVITY SUMMARY

The Project includes potential blasting activities in the areas shown on Exhibit A, based on the November 14th, 2017 *Sycamore V Hard Rock Exhibit* prepared by Boberg Engineering & Contracting, Inc. (3) To present a conservative approach, this analysis assumes that blasts would occur at the edge of the blasting areas indicated on Exhibit A. Based on information provided by the Project Applicant and the blasting contractor, California Drilling and Blasting Co., Inc., the blasts will be below-ground and will be partially, if not substantially, contained, depending on the depth of the hard rock areas within the Project site. Additional information provided by the blasting contractor, including calculation parameters, is included in the vibration and airblast calculations in Appendix A.

Blasting at the Project site is anticipated to occur during the grading stage of Project construction, which is estimated to last for roughly 60 days, with approximately seven to nine blasting events necessary to break the hard rock within the site. Alternative rock-breaking methods, if used, would be anticipated to result in a longer grading period duration of 122 days, with 47 days of rock-breaking activities including the use of excavators and impact hammer equipment.

BLASTING FUNDAMENTALS

The intensity of the noise and vibration impacts associated with rock blasting depends on location, size, material, shape of the rock, and the methods used to crack it. While a blasting contractor can design the blasts to stay below a given vibration level that could cause damage to nearby structures, it is difficult to design blasts that produce noise levels which are not perceptible to receivers near the blast site. (4) The noise produced by blasting activities is referred to as air overpressure, or an "airblast," which is generated when explosive energy in the form of gases escape from the detonating blast holes. Much like a point source, airblasts radiate outward in a spherical pattern and attenuate with each doubling of distance from the blast location, depending on the design of the blast and amount of containment.

Blasting activities generally include: the pre-drilling of holes in the hard rock area; preparation and placement of the charges in the drilled holes; a pre-blast horn signal; additional pre-blast horn signals immediately prior to the blast; and the blast itself. An additional horn signal is sounded to indicate the "all clear" after the blast and the blasting contractor has inspected the blasting area. The noise from the blast itself starts with a cracking sound from the detonator, located at a distance from the charges, and ends with the low crackling sound from each charge as they are subsequently set off. Blasts typically occur for only a few seconds, depending on their design. It is important to note that no other construction equipment will be operating during each blast in the blast area, but will commence operation once the blasting contractor indicates it is safe to do so. The following calculations, analyses, and findings provided in this letter are based on the 18th Edition of the *International Society of Explosives Engineer's (ISEE's) Blasters' Handbook*.

BLASTING VIBRATION LEVELS

Vibration levels generated by a blast can travel up to 20,000 feet per second, depending on the size of the blast, travel pathways (e.g., ground discontinuities), and site characteristics. (2) To determine potential vibration levels (PPV) from a blast, the square-root scaled distance (SD_2) is used based on the planned maximum charge weight of the blast, and distance to the receiver location being analyzed. The following equation is provided in the Blasters' Handbook to calculate the square-root scaled distance:

$$SD_2 = R / W^{1/2}$$

Where "R" is equal to the distance to the receiver location (e.g., residential homes), and "W" is equal to the maximum charge weight detonated within any 8-millisecond period per Blasters' Handbook guidelines. With known square-root scaled distances for each blast, the anticipated PPV levels can be calculated at the receiver location. The following equation is provided in the Blaster's Handbook for calculating vibration levels:

$$PPV = A \times (SD_2)^{-B}$$

Where "A" is equal to the intercept of a reference line with the calculated SD_2 value. The "A" values are based on the lower, best fit, or upper bound lines (provided in the Blasters' Handbook) for a given reference industry blast (e.g., construction, mining, etc.), and "B" is equal to the slope of the line.

PROJECT BLASTING VIBRATION LEVELS

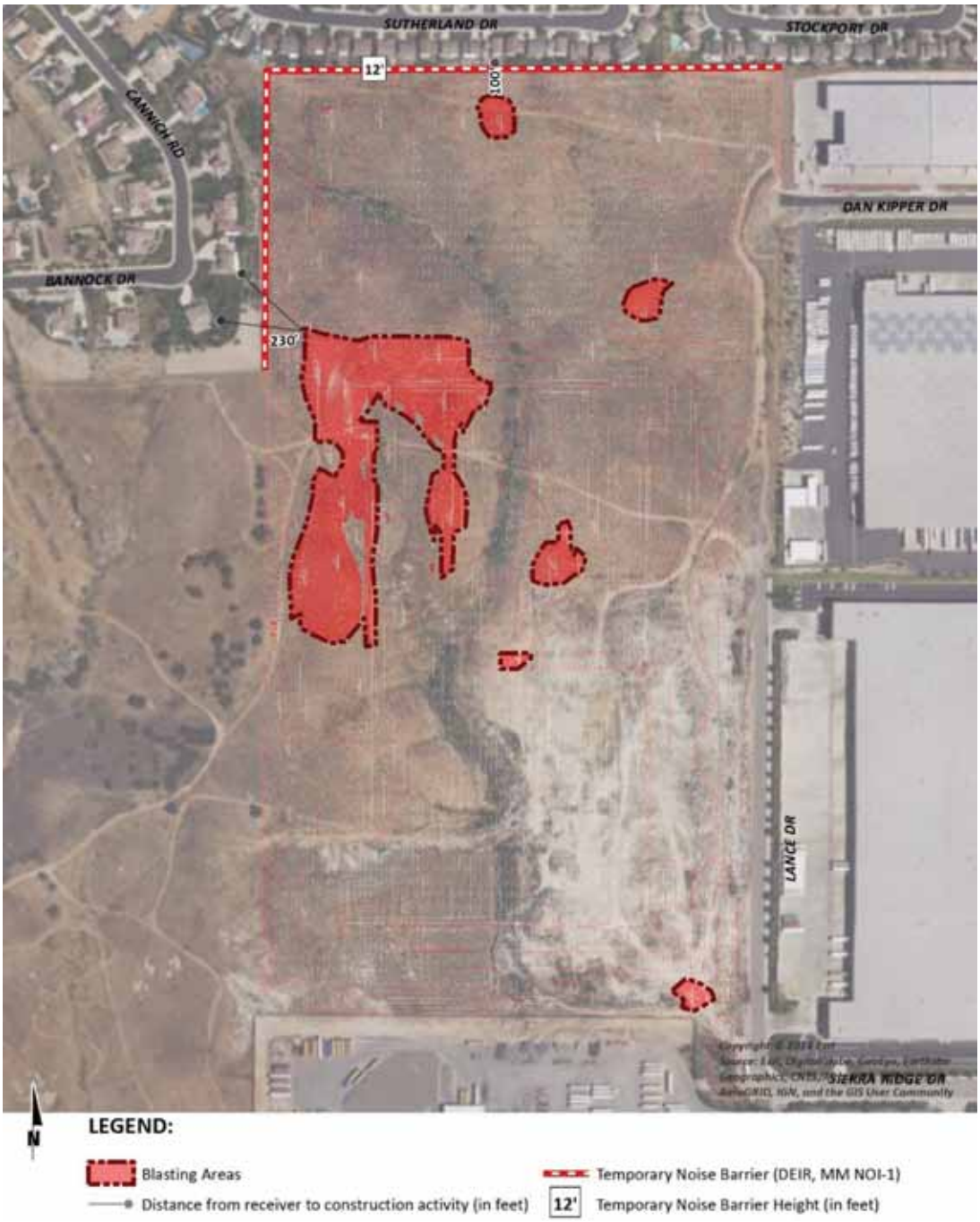
The following equation is used to calculate all PPV levels from Project blasts based on the ISEE's Blasters' Handbook equation for typical construction blasting vibration levels, and input from the blasting contractor:

$$PPV = 160 \times (SD_2)^{-1.6}$$

Table 1 shows the calculated vibration levels for the worst-case (closest) blast locations near the adjacent residential homes north and west of the Project site. The vibration levels of Project blasts are expected

to range from 0.35 to 0.37 in/sec PPV based on the distances to nearby residential homes, previously shown on Exhibit A. Calculations for both the northern and western blasting areas are provided in Appendix A.

EXHIBIT A: BLASTING ACTIVITY LOCATIONS



PROJECT BLASTING VIBRATION LEVEL COMPLIANCE

The Project blasting vibration levels ranging from 0.35 to 0.37 in/sec PPV will remain below the DEIR and Federal Transit Administration (FTA) threshold of 0.5 in/sec PPV, and therefore, represent a *less than significant* impact at the closest receiver locations.

BLASTING AIR OVERPRESSURE LEVELS

Air overpressure, or "airblast," levels generated by blasting can travel up to 1,100 feet per second, depending on the size of the blast, distance from the blast, and amount of charge confinement. (2) To determine potential airblast levels (dB) from a blast, the cubed-root scaled distance (SD_3) is used based on the planned maximum charge weight of the blast, and distance to the receiver location being analyzed. The following equation is provided in the Blasters' Handbook to calculate the cubed-root scaled distance:

$$SD_3 = R / W^{1/3}$$

Where "R" is equal to the distance to the receiver location (e.g., residential homes), and "W" is equal to the maximum charge weight detonated within any 8-millisecond period per Blasters' Handbook guidelines. With known cubed-root scaled distances for each blast, the anticipated airblast levels can be calculated at the receiver location. The following equation is provided in the Blaster's Handbook for calculating airblast levels in "P," which represents air pressure in pounds per inch squared (lbs/in^2):

$$P = A \times (SD_3)^{-B}$$

Where "A" is equal to the intercept of a reference line with the calculated SD_3 value. The "A" values are based on the Blasters' Handbook for a given reference industry blast (e.g., construction, mining, etc.), and vary depending on the amount of confinement of each blast. "B" is equal to the slope of the line per Blasters' Handbook reference data. It is important to note that airblast levels are calculated in terms of pressure in the air, and do not represent perceptible noise levels typically described using A-weighted decibels (dBA). Alternatively, airblast pressure levels can be converted to linear decibels (dB) using the following equation per the Blasters' Handbook:

$$P_s = 20 \times \log(P / P_0)$$

Where "P" equals the measured or calculated overpressure, and P_0 represents the reference ambient air pressure (2.9×10^{-9} pounds/$inch^2$) per the Blasters' Handbook.

PROJECT AIRBLAST LEVELS

The following equations are used to calculate the airblast levels from Project blasts based on the ISEE's Blasters' Handbook equation for partially and substantially confined construction blasts, determined based on the anticipated depth of hard rock in each location, between the range of highly confined blasts with an "A" value of 0.1, and average blasts with an "A" value of 1:

Northern Blast Location: $P = 0.5 \times (SD_3)^{-1.1}$

Western Blast Location: $P = 0.2 \times (SD_3)^{-1.1}$

Based on the above equation, the calculations provided in this letter represent an evaluation of partially and substantially confined airblast levels since they are calculated using the Blasters' Handbook equation for general construction blasting activities. Table 1 shows the calculated airblast levels from the worst-case (closest) Project blasting activities are expected to range from 115 to 126 dB. The results shown on Table 1 represent the worst-case (closest) blast locations describing the potential impacts when measured from the edge of the nearest blast area to the nearest receiver location. When measured at greater distances, the blasts will result in lower vibration and airblast levels. Calculations are provided in Appendix A.

PROJECT AIRBLAST COMPLIANCE

The Project airblast levels are shown to satisfy the 133 dB airblast threshold at the closest receiver locations as shown on Table 1. However, for a comparison with the previous findings of the DEIR, these linear airblast levels must first be converted to A-weighted hourly (L_{eq}) noise levels, as discussed in the next section.

TABLE 1: PROJECT BLASTING VIBRATION AND AIRBLAST LEVELS

Blasting Location[1]	Worst-Case Distance to Blasting	Blasting Levels[1]		Threshold[2]		Threshold Exceeded?[3]	
		Vibration (PPV)	Airblast (dB)	Vibration (PPV)	Airblast (dB)	Vibration (PPV)	Airblast (dB)
North Area	100'	0.37	126	0.5	133	No	No
West Area	230'	0.35	115	0.5	133	No	No

[1] Based on input data provided by California Drilling & Blasting. Calculations are provided in Appendix A for each blast location.
[2] Sources: Vibration threshold obtained from the City of Riverside Sycamore Canyon Business Park Buildings 1 and 2 Draft Environmental Impact Report, Page 5.12-37. Airblast threshold is based on ISEE's Blasters' Handbook, Table 26.17 Typical Air Overpressure Damage Criteria, and U.S. Bureau of Mines standards.
[3] Do the blast-related vibration and airblast levels exceed the thresholds?

AIRBLAST NOISE LEVEL CONVERSION

The ISEE's Blasters' Handbook specifically states that, "the usual rating terms associated with community noise standards are based on (A) weighted noise and do not apply to air overpressure from blasting operations." (2) However, for the purposes of this letter, and to provide an equivalent comparison with the noise mitigation thresholds previous identified in the DEIR, the following methods were used to convert the linear airblast levels (dB) to A-weighted (dBA) noise levels capable of evaluation against the 75 dBA L_{eq} level previously identified in the DEIR and MM NOI-1.

REFERENCE BLASTING NOISE LEVEL MEASUREMENT

To understand the frequency characteristics of blasting noise levels, Urban Crossroads, Inc. collected a reference noise level measurement of a blast performed by California Drilling and Blasting Co., Inc., on March 15th, 2016 at a residential construction site in the City of Chatsworth. At a reference distance of 370 feet, the blasting noise levels reached 109.3 dBA L_{max} for one second over a total measurement duration of 7 seconds for all blasts included in the event. The 1/3 octave band frequency noise levels measured during this reference blasting activity are used in this letter to determine the relationship between the overall 109.3 dBA L_{max} level, and each individual 1/3 octave band frequency level for the same measurement. (5)

LINEAR TO A-WEIGHTED NOISE LEVEL CONVERSION

To convert a linear noise level (dB) to an A-weighted (dBA) noise level necessary to compare with adopted noise level thresholds, adjustments are made to the linear sound levels at frequencies per American National Standards Institute S1.4 *Specifications for Sound Level Meters*. (6) However, the Blasters' Handbook does not provide guidance for calculating the airblast levels by frequency which would be required to apply the A-weighting curve to the calculated airblast levels previously provided on Table 1. As such, the reference noise level measurement of a residential construction blasting site, is used in this letter to describe the sound levels, by frequency, as they relate to the overall A-weighted reference blasting noise levels.

Based on the 1/3 octave band noise levels measured at the reference blasting site, the reference linear (dB) noise level is calculated by removing the A-weighted frequency level adjustments from the reference noise level measurement (109.3 dBA L_{max} at 370 feet) at each 1/3 octave band frequency per ANSI S1.4 standards. (5) This results in new linear noise levels at each 1/3 octave band frequency for the reference blasting noise level measurement. The relationship between each 1/3 octave band noise level and the combined linear (dB) noise level of the entire reference measurement is then calculated to arrive at an adjustment factor for each 1/3 octave band frequency. The difference in noise level at each 1/3 octave band frequency can then be subtracted from the linear Project airblast level at each 1/3 octave band to determine the 1/3 octave band frequencies based on the reference blasting noise level measurement characteristics. For the purposes of this analysis, the airblast levels of 115 dB and 126 dB, previously shown on Table 1, are used in this calculation to determine the linear to A-weighted relationship. Once the 1/3 octave band frequency noise levels are determined for the Project's worst-case (closest) airblast levels, the A-weighting curve is then applied to the linear airblast levels at the 1/3 octave band frequencies to arrive at a new, instantaneous L_{max} noise level for each blast. The instantaneous L_{max} noise levels can then be used to calculate the hourly (L_{eq}) construction noise level associated with Project blasting for comparison with the DEIR construction noise mitigation threshold of 75 dBA L_{eq}. Appendix B shows the conversion calculations of the airblast level to the hourly (L_{eq}) blasting noise levels.

L_{EQ} AND L_{MAX} NOISE LEVELS

For the purposes of this analysis, and based on the duration of the reference Chatsworth blasting measurement, it is assumed that blasts will occur for up to three-seconds. As such, the calculated instantaneous L_{max} noise level is assumed to occur for three of 60 seconds within a given minute of blasting activities at the Project site to arrive at a one-minute L_{eq}. Assuming no other construction equipment operates during the hour which blasting occurs, the one-minute L_{eq} blasting noise level is combined with the typical residential ambient noise level, as measured at locations LT1 and LT2 of the DEIR, at 54.0 dBA L_{eq} and 46.3 dBA L_{eq} , respectively, for the remaining 59 minutes of the hour. Table 2 summarizes the unmitigated airblast levels by noise level descriptor based on the above methodology. It is important to note that the unmitigated blasting levels shown on Table 2 do not include any additional attenuation due to intervening structures in the Project study area (berms, barriers, buildings, slopes, etc.).

TABLE 2: UNMITIGATED PROJECT BLASTING NOISE LEVEL SUMMARY

Blasting Location[1]	Worst-Case Distance to Blasting	Unmitigated Blasting Levels	
		Airblast Levels (dB)	One-Hour dBA Leq
North Area	100'	126	91.6
West Area	230'	115	80.8

Note that the worst-case blasting levels do not include any additional attenuation due to intervening structures or topographic changes in the Project study area (berms, barriers, buildings, slopes, etc.).

PROJECT BLASTING NOISE LEVEL COMPLIANCE

As previously shown on Table 2, the unmitigated Project airblasts are expected to result in unmitigated hourly construction noise levels ranging from 80.8 to 91.6 dBA L_{eq} at the residential homes north (100 feet) and west (230 feet) of the edge of the closest blasting areas. However, these unmitigated noise levels do not account for any additional attenuation due to intervening structures in the Project study area or topographic changes (berms, barriers, buildings, slopes, etc.). Table 3 shows the mitigated hourly dBA L_{eq} noise levels for each worst-case (closest) blast of Project blasting activities based on the Table 2 unmitigated airblast levels. As previously discussed, MM NOI-1 requires the installation of a 12-foot high temporary noise barrier at the northern and western property lines of the Project site during construction, and as such, the additional barrier attenuation is estimated to provide a noise level reduction of approximately 17.1 dBA L_{eq} for northern residential homes, due to the temporary noise barrier being located at the top of slope between the blast area elevation and the lower receiving residential homes.

No barrier attenuation from the 12-foot high temporary noise barrier is included in the calculation at the western residential homes, since the MM NOI-1 12-foot high temporary construction noise barrier will be located at the property line and at a lower elevation than the homes to the west, which are roughly

30 feet above the elevation of the Project site. For homes located west of the Project site, the attenuation provided by the topographic difference and existing earthen berm of 7.4 dBA L_{eq} is included in the analysis, as shown on Table 3. All barrier and berm attenuation calculations are provided in Appendix C.

As shown on Table 3, the hourly blasting noise levels are expected to range from 73.4 to 74.5 dBA L_{eq} when measured from the worst-case edge of the closest blasting areas within the Project site, which are shown to remain below the mitigated 75 dBA L_{eq} construction noise levels previously identified in MM NOI-1 of the DEIR.

TABLE 3: PROJECT BLASTING NOISE LEVEL COMPLIANCE

Blasting Location	Unmitigated Blasting Noise Levels (dBA L_{eq})	Barrier/Berm Attenuation (dBA L_{eq})	Blasting Noise Levels with Barrier/Berm Attenuation (dBA L_{eq})[2]	Threshold (dBA L_{eq})[2]	Threshold Exceeded?[3]
North Area	91.6	-17.1	74.5	75	No
West Area	80.8	-7.4	73.4	75	No

[1] Calculated barrier and berm attenuation are provided in Appendix C.
[2] Based on the previously identified construction noise level of 75 dBA L_{eq} with the 12-foot high temporary noise barrier as identified in MM NOI-1 of the DEIR.
[3] Do the Project blasting noise levels exceed the previous DEIR construction noise levels?

CONCLUSIONS

This Blasting Air Overpressure and Vibration Impact Assessment Letter for the Sycamore Canyon Project shows that the worst-case (closest) blasts at the edge of the Project blasting areas will generate construction noise levels that remain below the 75 dBA L_{eq} hourly construction noise mitigation threshold previously identified in MM NOI-1 of the DEIR, and result in vibration levels which will remain below the 0.5 in/sec PPV threshold. Further, regardless of this analysis, all blasts will be designed by the Project blasting contractor, California Drilling and Blasting Co., Inc., to remain below the 0.5 in/sec PPV vibration threshold at the time of Project blasting activities. If you have any questions, please contact me directly at (949) 336-5979.

Respectfully submitted,

URBAN CROSSROADS, INC.

Bill Lawson, P.E., INCE
Principal

Alex Wolfe, INCE
Analyst

REFERENCES

1. **City of Riverside.** *Sycamore Canyon Business Park Buildings 1 and 2 Draft Environmental Impact Report.* August 2016.
2. **International Society of Explosives Engineer's.** *Blasters' Handbook, 18th Edition.* 2014.
3. **Boberg Engineering & Contracting, Inc.** *Sycamore V Hard Rock Exhibit.* November 14, 2017.
4. **California Department of Transportation.** *Transportation and Construction Vibration Guidance Manual.* September 2013.
5. **Urban Crossroads, Inc.** *Reference Blasting Noise Level Measurement, Chatsworth, California.* March 15, 2016.
6. **American National Standards Institute (ANSI).** *Specification for Sound Level Meters ANSI S1.4-2014/IEC 61672-1:2013.*

APPENDIX A

BLASTING VIBRATION AND AIRBLAST CALCULATIONS

BLASTING INPUTS & CALCULATIONS

Scaled Distance

Source: ISEE's Blaster's Handbook, 2018 Edition.

Square Root Scaled Distance

$SD_2 = R / W^{1/2}$

R =	100	feet	Distance from blast to a point of intereste (meters or feet)
W =	5	lbs	Maximum charge-weigh detonated within any 8-millisecond period (kilograms or pounds)

SD_2 = **44.72** ft/lbs$^{1/2}$

Peak Particle Velocity

$PPV = A * (SD_2)^{-B}$

A =	160	**"Best Fit" 160 per blasting contractor guidance based on site conditions.**
SD_2 =	44.72	*All blasts will be designed on-site by the blasting contractor to remain below 0.5 in/sec PPV*
B =	1.6	Slope of the line (note that the slope is **negative** in the equation)

PPV = **0.37** in/sec

Vibration Amplitude Equations For Various Blasting Industries

Industry	Metric Equations mm/sec.	U.S. Equations in./sec.	Confidence level	Source
General	$PPV = 1{,}140(SD_2)^{-1.6}$	$PPV = 160(SD_2)^{-1.6}$	Best Fit	DuPont
Construction	$PPV = 173(SD_2)^{-1.6}$	$PPV = 24.2(SD_2)^{-1.6}$	Lower Bound	Oriard
Construction	$PPV = 1{,}730(SD_2)^{-1.6}$	$PPV = 242(SD_2)^{-1.6}$	Upper Bound	Oriard (2005)
Construction	$PPV = 4{,}320(SD_2)^{-1.6}$	$PPV = 605(SD_2)^{-1.6}$	Upper Bound - High Confinement	Oriard (2005)
Construction	$PPV = 53(SD_2)^{-1.09}$	$PPV = 5(SD_2)^{-1.09}$	Best Fit	USBM RI 8507
Quarries	$PPV = 1{,}090(SD_2)^{-1.82}$	$PPV = 182(SD_2)^{-1.82}$	Best Fit	USBM Bulletin 656
Coal Mines	$PPV = 905(SD_2)^{-1.52}$	$PPV = 119(SD_2)^{-1.52}$	Best Fit	USBM RI 8507
Coal Mines	$PPV = 3{,}330(SD_2)^{-1.52}$	$PPV = 438(SD_2)^{-1.52}$	Upper bound	USBM RI 8507
Coal - Low Frequency sites	$PPV = 1{,}252(SD_2)^{-1.31}$	$PPV = 138(SD_2)^{-1.31}$	Best Fit	USBM RI 9226

Air Overpressure/Airblast

Cubed Root Scaled Distance

$SD_3 = R / W^{1/3}$

R =	100	feet	Distance from blast to a point of intereste (meters or feet)
W =	5	lbs	Maximum charge-weigh detonated within any 8-millisecond period (kilograms or pounds)

SD_3 = **58.48** ft/lbs$^{1/3}$

Air Overpressure Prediction

$P = A * SD_3^{-B}$

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NorthBlast

A =	0.5	Partially confined; shallower depth than western blasts.
SD_3 =	58.48	
B =	1.1	Slope of the line (note that the slope is negative)

P = 0.0057 psi

Air Overpressure Prediction Equations

Blasting	Metric Equations mb	U.S. Equations psi	Statistical Type	Source
Open air (no confinement)	$P = 3589 \times SD_3^{-1.38}$	$P = 187 \times SD_3^{-1.38}$	Best Fit	Perkins
Coal mines (parting)	$P = 2596 \times SD_3^{-1.62}$	$P = 169 \times SD_3^{-1.62}$	Best Fit	USBM RI 8485
Coal mines (highwall)	$P = 5.37 \times SD_3^{-0.79}$	$P = 0.162 \times SD_3^{-0.79}$	Best Fit	USBM RI 8485
Quarry face	$P = 37.1 \times SD_3^{-0.97}$	$P = 1.32 \times SD_3^{-0.97}$	Best Fit	USBM RI 8485
Metal Mine	$P = 14.3 \times SD_3^{-0.71}$	$P = 0.401 \times SD_3^{-0.71}$	Best Fit	USBM RI 8485
Construction (average)	$P = 24.8 \times SD_3^{-1.1}$	$P = 1 \times SD_3^{-1.1}$	Best Fit	Oriard (2005)
Construction (highly confined)	$P = 2.48 \times SD_3^{-1.1}$	$P = 0.1 \times SD_3^{-1.1}$	Best Fit	Oriard (2005)
Buried (total confinement)	$P = 1.73 \times SD_3^{-0.96}$	$P = 0.061 \times SD_3^{-0.96}$	Best Fit	USBM RI 8485

Decibels (Linear)

$P_s = 20 * \log(P / P_0)$

P =	0.0057 psi	
P_0 =	2.9E-09 pascals	Reference value: $2.9 * 10^{-9}$ lbs/inch^2

P_s = 125.86 dB

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BLASTING INPUTS & CALCULATIONS

Scaled Distance

Source: ISEE's Blaster's Handbook, 2018 Edition.

Square Root Scaled Distance

$SD_2 = R / W^{1/2}$

R =	230	feet	Distance from blast to a point of intereste (meters or feet)
W =	25	lbs	Maximum charge-weigh detonated within any 8-millisecond period (kilograms or pounds)

SD_2 = 46.00 ft/lbs$^{1/2}$

Peak Particle Velocity

$PPV = A * (SD_2)^{-B}$

A =	160	**"Best Fit" 160 per blasting contractor guidance based on site conditions.**
SD_2 =	46.00	*All blasts will be designed on-site by the blasting contractor to remain below 0.5 in/sec PPV*
B =	1.6	Slope of the line (note that the slope is **negative** in the equation)

PPV = 0.35 in/sec

Vibration Amplitude Equations For Various Blasting Industries

Industry	Metric Equations mm/sec.	U.S. Equations in./sec.	Confidence level	Source
General	$PPV = 1{,}140(SD_2)^{-1.6}$	$PPV = 160(SD_2)^{-1.6}$	Best Fit	DuPont
Construction	$PPV = 173(SD_2)^{-1.6}$	$PPV = 24.2(SD_2)^{-1.6}$	Lower Bound	Oriard
Construction	$PPV = 1{,}730(SD_2)^{-1.6}$	$PPV = 242(SD_2)^{-1.6}$	Upper Bound	Oriard (2005)
Construction	$PPV = 4{,}320(SD_2)^{-1.6}$	$PPV = 605(SD_2)^{-1.6}$	Upper Bound - High Confinement	Oriard (2005)
Construction	$PPV = 53(SD_2)^{-1.09}$	$PPV = 5(SD_2)^{-1.09}$	Best Fit	USBM RI 8507
Quarries	$PPV = 1{,}090(SD_2)^{-1.82}$	$PPV = 182(SD_2)^{-1.82}$	Best Fit	USBM Bulletin 656
Coal Mines	$PPV = 905(SD_2)^{-1.52}$	$PPV = 119(SD_2)^{-1.52}$	Best Fit	USBM RI 8507
Coal Mines	$PPV = 3{,}330(SD_2)^{-1.52}$	$PPV = 438(SD_2)^{-1.52}$	Upper bound	USBM RI 8507
Coal - Low Frequency sites	$PPV = 1{,}252(SD_2)^{-1.31}$	$PPV = 138(SD_2)^{-1.31}$	Best Fit	USBM RI 9226

Air Overpressure/Airblast

Cubed Root Scaled Distance

$SD_3 = R / W^{1/3}$

R =	230	feet	Distance from blast to a point of intereste (meters or feet)
W =	25	lbs	Maximum charge-weigh detonated within any 8-millisecond period (kilograms or pounds)

SD_3 = 78.66 ft/lbs$^{1/3}$

Air Overpressure Prediction

$P = A * SD_3^{-B}$

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WestBlast

A =	0.2	Partially - highly confined.
SD_3 =	78.66	
B =	1.1	Slope of the line (note that the slope is negative)

P = 0.0016 psi

Air Overpressure Prediction Equations

Blasting	Metric Equations mb	U.S. Equations psi	Statistical Type	Source
Open air (no confinement)	$P = 3589 \times SD_3^{-1.38}$	$P = 187 \times SD_3^{-1.38}$	Best Fit	Perkins
Coal mines (parting)	$P = 2596 \times SD_3^{-1.62}$	$P = 169 \times SD_3^{-1.62}$	Best Fit	USBM RI 8485
Coal mines (highwall)	$P = 5.37 \times SD_3^{-0.79}$	$P = 0.162 \times SD_3^{-0.79}$	Best Fit	USBM RI 8485
Quarry face	$P = 37.1 \times SD_3^{-0.97}$	$P = 1.32 \times SD_3^{-0.97}$	Best Fit	USBM RI 8485
Metal Mine	$P = 14.3 \times SD_3^{-0.71}$	$P = 0.401 \times SD_3^{-0.71}$	Best Fit	USBM RI 8485
Construction (average)	$P = 24.8 \times SD_3^{-1.1}$	$P = 1 \times SD_3^{-1.1}$	Best Fit	Oriard (2005)
Construction (highly confined)	$P = 2.48 \times SD_3^{-1.1}$	$P = 0.1 \times SD_3^{-1.1}$	Best Fit	Oriard (2005)
Buried (total confinement)	$P = 1.73 \times SD_3^{-0.96}$	$P = 0.061 \times SD_3^{-0.96}$	Best Fit	USBM RI 8485

Decibels (Linear)

$P_s = 20 * \log(P / P_0)$

P =	0.0016 psi	
P_0 =	2.9E-09 pascals	Reference value: $2.9 * 10^{-9}$ lbs/inch^2

P_s = 115.07 dB

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APPENDIX B

LINEAR TO A-WEIGHTED DECIBEL CONVERSION

Linear Airblast to A-Weighted Noise Level Conversion

Worst-Case Airblast (dB) Level **126** **dB (linear) at** **100 feet**

Airblast level is based on both the distance to the receiver and the maximum charge weight of the blast.

Frequency levels based on reference Chatsworth blasting measurement by Urban Crossroads, Inc. on March 15, 2016.

Noise Type	1/3 Octave Band Frequencies									Combined Levels
	31.5	63	125	250	500	1000	2000	4000	8000	
Reference Noise Level[1]	63	68.6	69.1	65.7	95.3	106.6	82.6	77	70.5	109.3
A-Weighting Curve[2]	-39.4	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1	-
Resulting Reference Linear dB	102.4	94.8	85.2	74.3	98.5	106.6	81.4	76	71.6	108.7
Linear Total vs. 1/3 Octave Bands (108.7 dB - Each 1/3 Octave)	6.3	13.9	23.5	34.4	10.2	2.1	27.3	32.7	37.1	-
Worst-Case Airblast dB by 1/3 Octave (101.8 dB + each 1/3 octave adj.)	**119.6**	**112.0**	**102.4**	**91.5**	**115.7**	**123.8**	**98.6**	**93.2**	**88.8**	**125.9**

[1] Urban Crossroads, Inc. collected a reference noise level measurement of a blast performed by California Drilling and Blasting, on March 15th, 2016 at a residential construction site in the City of Chatsworth. At a reference distance of 370 feet, the blasting noise levels reached 109.3 dBA L_{max} for one second over a total duration of 7 seconds for all blasts included in the event.

[2] Source: American National Standards Institute, Specification for Sound Level Meters ANSI S1.4-2014/IEC 61672-1:2013.

Applying A-Weighting to Linear Frequency Levels

Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000
dB(A) Weighting	-39.4	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1
Linear Spectrum	119.6	112.0	102.4	91.5	115.7	123.8	98.6	93.2	88.8
dB(A) Value	**124.1 dBA L_{max}**								

Blast L_{max} over 60-second minute

109.3 dBA Leq **1-minute**

Blast L_{eq} over 60-minute hour

91.6 dBA Leq **1-hour**

URBAN CROSSROADS

Linear Airblast to A-Weighted Noise Level Conversion

Worst-Case Airblast (dB) Level **115** **dB (linear) at** **230 feet**

Airblast level is based on both the distance to the receiver and the maximum charge weight of the blast.

Frequency levels based on reference Chatsworth blasting measurement by Urban Crossroads, Inc. on March 15, 2016.

Noise Type	1/3 Octave Band Frequencies									Combined Levels
	31.5	63	125	250	500	1000	2000	4000	8000	
Reference Noise Level[1]	63	68.6	69.1	65.7	95.3	106.6	82.6	77	70.5	109.3
A-Weighting Curve[2]	-39.4	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1	-
Resulting Reference Linear dB	102.4	94.8	85.2	74.3	98.5	106.6	81.4	76	71.6	108.7
Linear Total vs. 1/3 Octave Bands (108.7 dB - Each 1/3 Octave)	6.3	13.9	23.5	34.4	10.2	2.1	27.3	32.7	37.1	-
Worst-Case Airblast dB by 1/3 Octave (101.8 dB + each 1/3 octave adj.)	**108.8**	**101.2**	**91.6**	**80.7**	**104.9**	**113.0**	**87.8**	**82.4**	**78.0**	**115.1**

[1] Urban Crossroads, Inc. collected a reference noise level measurement of a blast performed by California Drilling and Blasting, on March 15th, 2016 at a residential construction site in the City of Chatsworth. At a reference distance of 370 feet, the blasting noise levels reached 109.3 dBA L_{max} for one second over a total duration of 7 seconds for all blasts included in the event.

[2] Source: American National Standards Institute, Specification for Sound Level Meters ANSI S1.4-2014/IEC 61672-1:2013.

Applying A-Weighting to Linear Frequency Levels

Frequency (Hz)	31.5	63	125	250	500	1000	2000	4000	8000
dB(A) Weighting	-39.4	-26.2	-16.1	-8.6	-3.2	0	1.2	1	-1.1
Linear Spectrum	108.8	101.2	91.6	80.7	104.9	113.0	87.8	82.4	78.0
dB(A) Value	**113.3 dBA L_{max}**								

Blast L_{max} over 60-second minute

98.6 dBA Leq **1-minute**

Blast L_{eq} over 60-minute hour

80.8 dBA Leq **1-hour**

URBAN CROSSROADS

APPENDIX C

BARRIER/BERM ATTENUATION CALCULATIONS

STATIONARY SOURCE NOISE PREDICTION MODEL

12/4/2017

Observer Location: **North Residential**
Source: Northern Blasting
Condition: Blasting

Project Name: Sycamore
Job Number: 11431
Analyst: A. Wolfe

NOISE MODEL INPUTS

Noise Distance to Observer	100.0	feet	***Barrier Height:***	**12.0 feet**
Noise Distance to Barrier:	90.0	feet	*Noise Source Height:*	1.0 feet
Barrier Distance to Observer:	10.0	feet	*Observer Height:*	5.0 feet
Observer Elevation:	1,590.0	feet	*Barrier Type (0-Wall, 1-Berm):*	0
Noise Source Elevation:	1,600.0	feet	*Drop Off Coefficient:*	20.0
Barrier Elevation:	1,600.0	feet		

20 = 6 dBA per doubling of distance
15 = 4.5 dBA per doubling of distance

NOISE MODEL PROJECTIONS

Noise Level	*Distance (feet)*	*Leq*	*L50*	*L25*	*L8*	*L2*	*Lmax*
Reference (Sample)	100.0	91.6	0.0	0.0	0.0	0.0	0.0
Distance Attenuation	100.0	0.0	0.0	0.0	0.0	0.0	0.0
Shielding (Barrier Attenuation)	90.0	-17.1	-17.1	-17.1	-17.1	-17.1	-17.1
Raw (Distance + Barrier)		74.5	-17.1	-17.1	-17.1	-17.1	-17.1
60 Minute Hourly Adjustment		**74.5**	**-17.1**	**-17.1**	**-17.1**	**-17.1**	**-17.1**

STATIONARY SOURCE NOISE PREDICTION MODEL

12/4/2017

Observer Location: **West Residential**
Source: Western Blasting
Condition: Blasting

Project Name: Sycamore
Job Number: 11431
Analyst: A. Wolfe

NOISE MODEL INPUTS

Noise Distance to Observer	230.0	feet	***Barrier Height:***	**30.0 feet**
Noise Distance to Barrier:	160.0	feet	*Noise Source Height:*	1.0 feet
Barrier Distance to Observer:	70.0	feet	*Observer Height:*	5.0 feet
Observer Elevation:	1,625.0	feet	*Barrier Type (0-Wall, 1-Berm):*	1
Noise Source Elevation:	1,595.0	feet	*Drop Off Coefficient:*	20.0
Barrier Elevation:	1,595.0	feet		

20 = 6 dBA per doubling of distance
15 = 4.5 dBA per doubling of distance

NOISE MODEL PROJECTIONS

Noise Level	*Distance (feet)*	*Leq*	*L50*	*L25*	*L8*	*L2*	*Lmax*
Reference (Sample)	230.0	80.8	0.0	0.0	0.0	0.0	0.0
Distance Attenuation	230.0	0.0	0.0	0.0	0.0	0.0	0.0
Shielding (Barrier Attenuation)	160.0	-7.4	-7.4	-7.4	-7.4	-7.4	-7.4
Raw (Distance + Barrier)		73.4	-7.4	-7.4	-7.4	-7.4	-7.4
60 Minute Hourly Adjustment		**73.4**	**-7.4**	**-7.4**	**-7.4**	**-7.4**	**-7.4**