wjv acoustics

November 28, 2018

Mr. Justin Batey
HAGEMAN LAND PARTNERS, LLC
PO Box 20247
Bakersfield, California 93390

RE: GPA/ZC NO. 18-0448 LOCATED ON SANTA FE WAY BETWEEN RENFRO ROAD AND LEONARD ALVARADO ROAD (APN 529-012-37)

Dear Mr. Batey:

As you have requested, WJV Acoustics, Inc. (formerly Brown-Buntin Associates, Inc.) provides the following response in regards to requested item 1. g. provided in a letter from The City of Bakersfield Development Services Department, dated November 26, 2018. The requested item states the following:

> *"**Noise Study.** Given the proximity of existing and future residential land uses adjacent to light industrial, the Planning Division will require a Noise Study by a qualified noise specialist, at the applicant's expense, to determine if construction and/or operational noise will result in significant effects to nearby land uses."*

Due to the uncertainty as to future land uses and tenants that could be located at the currently undeveloped adjacent M-1 parcel, providing appropriate noise mitigation measures is considered to be problematic. M-I (light industrial) uses could include the use of stationary mechanical equipment and/or mobile equipment sources that could generate noise levels in excess of the noise element standards.

Per approved Mitigation Measure 8 of the acoustical analysis previously prepared for the adjacent 94.2-acre parcel (dated October 6, 2014 and attached for reference), it is the opinion of WJVA that when specific uses have been identified, noise mitigation should be part of the project

design. Mitigation Measure 8 provided in the above-described acoustical analysis states the following:

> *"Noise mitigation measures should be considered when specific uses within the M-1 development area are proposed. Mitigation measures could include equipment enclosures, the use of buildings or other structures to acoustically shield nearby R-1 uses or the construction of sound walls higher than required for traffic and railroad noise mitigation between M-1 and R-1 uses."*

Please contact me at 559-627-4923 or walter@wjvacoustics.com if there are questions or additional information is required.

Respectfully submitted,

WJV ACOUSTICS, INC.

Walter J. Van Groningen
President

WJV:wjv

ACOUSTICAL ANALYSIS

94.2 ACRE MIXED-USE DEVELOPMENT
SANTA FE WAY AND RENFRO ROAD
KERN COUNTY, CALIFORNIA

BBA Report No. 14-039

PREPARED FOR

ROSEDALE LAND & DEVELOPMENT, INC.
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BAKERSFIELD, CALIFORNIA 93390

PREPARED BY

BROWN-BUNTIN ASSOCIATES, INC.
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OCTOBER 6, 2014

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BBA
BROWN • BUNTIN
ASSOCIATES, INC.

INTRODUCTION

The project is a proposed 94.2 acre mixed-use development located on the west side of Santa Fe Way south of Renfro Road in Kern County, California. The project would include 80.8 acres of R-1 residential lots, 6.0 acres of R-2 residential development and 7.4 acres of M-1 uses. The project site is exposed to existing noise from traffic on Santa Fe Way and Renfro Road, rail operations on the Burlington Northern Santa Fe Railway (BNSF), maintenance activities and vehicle movements at the Rosedale Union School District bus transportation facility (bus barn) and oil pumping operations located at various locations throughout or adjacent to the site.

This acoustical analysis, prepared by Brown-Buntin Associates, Inc. (BBA), is intended to quantify noise from existing or potential future sources affecting the site and determine the type and extent of noise mitigation that may be required for compliance with applicable Kern County noise level standards. The analysis is based upon information provided by the project developer, traffic data obtained from the Kern Council of Governments (Kern COG) and on-site noise measurements conducted by BBA. Revisions to the site plan or other project-related information available to BBA at the time the analysis was prepared may require a reevaluation of the findings and/or recommendations of the report.

Appendix A provides definitions of the acoustical terminology used in this report. Unless otherwise stated, all sound levels reported in this analysis are A-weighted sound pressure levels in decibels (dB). A-weighting de-emphasizes the very low and very high frequencies of sound in a manner similar to the human ear. Most community noise standards utilize A-weighted sound levels, as they correlate well with public reaction to noise.

CRITERIA FOR ACCEPTABLE NOISE EXPOSURE

Although the project is located within the unincorporated area of Kern County, the project is in the planning area of the Metropolitan Bakersfield General Plan. The applicable standards for noise levels that apply to this project are contained within Chapter VII of the Metropolitan Bakersfield General Plan adopted in 2002. No federal or state noise standards are applicable to this project.

For transportation noise sources (e.g., traffic and railway noise), the Noise Element of the General Plan sets a standard of 65 dB CNEL at the exterior of noise-sensitive uses. Noise-sensitive uses include residences, schools, hospitals and recreational areas. An interior noise standard of 45 dB CNEL applies within interior living spaces.

For non-transportation noise sources (e.g., commercial property), the noise element applies hourly noise levels performance standards at residential and other noise-sensitive uses. Table 1 summarizes the applicable hourly noise level standards.

TABLE I

HOURLY NOISE LEVEL PERFORMANCE STANDARDS
STATIONARY NOISE SOURCES
METROPOLITAN BAKERSFIELD GENERAL PLAN

Maximum Acceptable Noise Level, dB		
Min./Hr. (L_n)	**Day (7a-10p)**	**Night (10p-7a)**
30 (L_{50})	55	50
15 (L_{25})	60	55
5 ($L_{8.3}$)	65	60
1 ($L_{1.7}$)	70	65
0 (L_{max})	75	70

Note: L_n means the percentage of time the noise level is exceeded during an hour. L_{50} means the level exceed 50% of the hour, L_{25} is the level exceed 25% of the hour, etc.

Source: Metropolitan Bakersfield General Plan

PROJECT SITE NOISE EXPOSURE

Existing sources of noise within and adjacent to the project site include traffic on Santa Fe Way and Renfro Road, railroad operations on the BNSF Railway and commercial activities related to nearby oil wells and the Rosedale Union School District (RUSD) bus barn. There is a developed residential subdivision to the south of the site. Santa Fe Way, the BNSF Railway and the RUSD bus barn are located to the east of the site. Existing oil wells are located at several locations within and near the project site. The site is generally flat and at approximately the same elevation as adjacent properties. The project site plan provided by the project developer is shown in Figure 1.

Traffic Noise levels:

Noise levels from traffic on Santa Fe Way and Renfro Road were calculated for projected future conditions based upon noise measurements conducted by BBA at the project site, the Federal Highway Administration (FHWA) Highway Traffic Noise Prediction Model (FHWA-RD-77-108) and traffic data obtained from Kern COG.

The FHWA Model is a standard analytical method used for roadway traffic noise calculations. The model is based upon reference energy emission levels for automobiles, medium trucks (2 axles) and heavy trucks (3 or more axles), with consideration given to vehicle volume, speed, roadway configuration, distance to the receiver, and the acoustical characteristics of the site. The FHWA Model was developed to predict hourly L_{eq} values for free-flowing traffic conditions, and is generally considered to be accurate within ±1.5 dB. To predict CNEL values, it is necessary to determine the hourly distribution of traffic for a typical day and adjust the traffic volume input data to yield an equivalent hourly traffic volume.

Noise level monitoring and a concurrent traffic count were conducted by BBA within the project site on September 23, 2014. The purpose of the noise monitoring was to evaluate the accuracy

of the FHWA Model in describing traffic noise exposure within the project site. The traffic noise monitoring site was located approximately 230 feet from the center of Santa Fe Way. Traffic noise monitoring was not conducted along Renfro Road due to the very low existing traffic volumes on that roadway. The traffic noise monitoring site is shown in Figure 1.

Noise monitoring equipment consisted of a Larson-Davis Laboratories Model LDL-820 sound level analyzer equipped with a B&K Type 4176 1/2" microphone. The equipment complies with the specifications of the American National Standards Institute (ANSI) for Type I (Precision) sound level meters. The microphone was placed on a tripod at approximately 5 feet above the ground. The instrumentation was calibrated prior to use with a B&K Type 4230 acoustic calibrator to ensure the accuracy of the measurements.

Noise measurements were conducted in terms of the equivalent energy sound level (L_{eq}). Measured L_{eq} values were compared to L_{eq} values calculated (predicted) by the FHWA Model using as inputs the traffic volumes, truck mix and vehicle speed observed during the noise measurements. The results of that comparison are shown in Table II.

TABLE II

COMPARISON OF MEASURED AND PREDICTED (FHWA MODEL) TRAFFIC NOISE LEVELS 94.2 ACRE DEVELOPMENT SANTA FE WAY

Date	September 23, 2014
Time	9:40 a.m.
Observed # Autos/Hr.	404
Observed # Medium Trucks/Hr.	16
Observed # Heavy Trucks/Hr.	12
Posted Speed (MPH)	55
Distance, ft. (from center of Santa Fe Way)	230
L_{eq}, dB (Measured)	57.7
L_{eq}, dB (Predicted)	58.6
Difference between Measured and Predicted L_{eq}, dB	**0.9**

Note: FHWA "soft" site assumed for calculations.

Source: Brown-Buntin Associates, Inc.

From Table II it may be determined that the predicted traffic noise level was 0.9 dB higher than the measured noise level for the traffic conditions observed at the time of the noise measurements. This is considered acceptable agreement between predicted and measured results, and indicates that FHWA Model may be used without adjustment to calculate annual average traffic noise exposure within the site.

The future (2035) annual average daily traffic (AADT) volumes for Santa Fe Way and Renfro Road in the vicinity of the project site were obtained from Kern COG. The percentages of medium and heavy trucks and the day/evening/night distribution of traffic were estimated by BBA based upon studies conducted along similar roadways since project-specific data were not available from government sources. Table III summarizes the traffic data assumptions used to model noise exposure from traffic on Santa Fe Way and Renfro Road within the project site. The data summarized in Table III represent the best information known to BBA at the time this analysis was prepared.

Using data from Table III and the FHWA Model, annual average future (2035) traffic noise exposure was calculated for the project site. At the closest proposed R-1 residential lots to Santa Fe Way (estimated to be approximately 300 feet from the center of the roadway) the calculated traffic noise exposure was 59.6 dB CNEL. At the closest proposed R-1 residential lots to Renfro Road (estimated to be approximately 65 feet from the center of the roadway) the calculated traffic noise exposure was 59.3 dB CNEL. At the closest point of the proposed R-2 residential development area (estimated to be approximately 65 feet from the center of Santa Fe Way) the calculated future traffic CNEL was 69.6 dB.

TABLE III

TRAFFIC NOISE MODELING ASSUMPTIONS
FUTURE CONDITIONS (2035)
94.2 ACRE MIXED-USE DEVELOPMENT
KERN COUNTY

	Santa Fe Way	**Renfro Road**
Annual Avenue Daily Traffic (AADT)	32,943	4,163
Day/Evening/Night Split (%)	85/5/10	85/5/10
Posted Vehicle Speed (mph)	45	40
% Medium Trucks (% AADT)	1.5	1.5
% Heavy Trucks (% AADT)	0.5	0.5

Sources: Kern COG
Brown-Buntin Associates, Inc.

Railroad Noise Levels:

The BNSF Railway is located on the east side of Santa Fe Way. The railroad consists of a single track mainline that is approximately 2-3 feet above the elevation of the project site. The closest railroad grade crossing is located at Reina Road, approximately 1,000 feet north of the project site. Railroad engine crews are required to blow the warning horn as they are approaching grade crossings. The closest proposed R-1 residential lots would be located approximately 370 feet from the center of the track. The closet R-2 development would be located at approximately 265 feet from the center of the track.

Noise level measurements of train pass-bys were conducted on September 23, 2014 at the same location previously described for traffic noise measurements at approximately 300 feet from the

center of the track. Noise monitoring equipment was the same as used for the traffic noise measurements. A total of nine train pass-bys was monitored, including six freight trains and three passenger (Amtrak) trains. Measured maximum noise levels ranged from 77.2 to 86.3 dBA, depending upon the use of the horn while approaching the Reina Road grade crossing. Measured sound exposure levels (SEL) ranged from 83.2 to 96.5 dB. The mean SEL for freight trains was 94.8 dB. The mean SEL for passenger trains was 84.1 dB. Train horns were audible, but the dominant railroad noise source was the locomotives and passing rail cars.

The Community Noise Equivalent Level (CNEL) is calculated based on the mean SEL of trains (discussed above), the number of daily trains, and their day/evening/night distribution. Table IV lists operational data used for calculations. The calculated railroad noise exposure at the closest proposed R-1 lots was 65.8 dB CNEL. At the closest proposed R-2 residential development the calculated railroad exposure was 68.0 dB CNEL.

TABLE IV

RAILROAD OPERATIONAL DATA
BNSF RAILWAY-BAKERSFIELD AREA

# Freight Trains/Day	32
# Passenger Trains/Day	12
Day/Evening/Night Split (Freight)[1]	50%/13%/37%
Day/Evening/Night Split (Passenger)	67%/8%/25%

[1]Assumed to be evenly distributed over 24 hours.

Sources: Federal Railroad Administration website
Amtrak website

Oil Well Noise Levels:

There are a total of nine oil wells located within the project area. The well locations are noted on Figure 1. Not all of the wells are developed at this time. Two of the wells (KAPEG-1 and KAPEG-2) were being pumped at the time of the study and another two wells (ARCO-35X and ARCO 36X) were previously measured by BBA for another residential project to the south of the project site. Noise level measurements at the operating wells were conducted by BBA at distances ranging from 30-50 feet from the pump engines using the same equipment as previously described for traffic and rail measurements. Table V summarizes noise measurement results. Noise measurement results have been normalized to a reference distance of 50 feet using the normal attenuation of sound from a point noise source (6 dB per each doubling/halving of distance).

Table V shows that average (L_{eq} and L_{50}) noise levels from the wells ranged from 58.8 to 65.2 dB at a reference distance of 50 feet from the pump engine. The noise levels produced by individual wells were more or less constant with little difference in noise levels as defined by the statistical descriptors (L_{50}, L_5, etc.) of the noise element. Since the L_{50} is the most stringent noise standard, it was used to determine compliance with the stationary noise source standards of the

noise element (Table I). It is assumed that the wells may operate at any time during the daytime or nighttime hours, so the more restrictive nighttime standard has been applied to this analysis.

TABLE V

OIL WELL NOISE LEVEL MEASUREMENTS
94.2 ACRE MIXED-USE DEVELOPOMENT
@50 FEET FROM PUMP ENGINE

	Date	A-weighted Noise Level @ 30 Feet, dB					
		L_{eq}	L_{50}	L_{25}	$L_{8.3}$	$L_{1.7}$	L_{max}
KAPEG-1	9/23/14	62.6	62.6	63.4	63.9	65.1	65.3
KAPEG-2	9/23/14	58.8	57.7	58.7	62.3	63.7	63.9
ARCO-35X	8/20/08	65.0	65.0	65.3	65.6	65.7	65.7
ARCO-36X	8/20/08	65.2	65.2	65.7	66.5	67.3	67.5
Source: Brown-Buntin Associates, Inc.							

The nighttime standard of the noise element for stationary noise sources is an L_{50} of 50 dB. Based upon measured noise levels as summarized in Table V, oil well noise levels could exceed the nighttime L_{50} standard by 8.8-15.2 dB at a distance of 50 feet, depending upon which well is being considered.

Bus Barn Noise Levels:

The RUSD bus barn is located approximately 400 feet from the closest proposed residential lots. The bus barn is a school bus parking and maintenance facility. There is a six foot-high masonry wall located along the western and northern boundaries of the bus barn facility that acoustically shields the project site from bus barn activities. During the site inspection, noise levels from bus barn activities were occasionally audible but not significant when compared to noise from traffic on Santa Fe Way or railroad operations. Noise from the bus barn facility would not be expected to exceed the stationary noise source standards of the noise element.

NOISE MITIGATION

Noise from traffic on Santa Fe Way and rail operations on the BNSF Railway must be combined for comparison to the applicable transportation noise source standards along the east side of the project. Since the specific type of development that may occur within the 7.4 acre M-1 and 6.0 acre R-2 sections of the project site was unknown to BBA at the time this analysis was prepared, it has been assumed that there will be no intervening buildings between the railroad and traffic noise sources and the eastern edge of the proposed R-1 residential lots.

Exterior Noise Exposure:

The closest proposed R-1 residential lots would be approximately 370 feet and 300 feet from the center of the railroad track and Santa Fe Way, respectively, in the northern portion of the project site. When railroad and traffic noise levels are combined, the resulting noise exposure is 66.7 dB

CNEL. This exceeds the 65 dB CNEL exterior standard of the noise element and means that noise mitigation will be required. South of approximately the Noriega Road alignment, the distance from the railroad to the closest R-I lots increases to approximately 565 feet. In this area of the development, the combined railroad and traffic noise exposure is 64.7 dB CNEL. This does not exceed the 65 dB CNEL standard.

The closest proposed R-2 development is assumed to be approximately 65 feet from the center of Santa Fe Way and 265 feet from the center of the railroad track. When railroad and traffic noise levels are combined, the resulting noise exposure is 71.9 dB CNEL. This exceeds the 65 dB CNEL exterior standard of the noise element and means that noise mitigation will be required.

Along Renfro Road on the western side of the project site, proposed R-1residential lots would be exposed to a traffic noise level of 59.3 dB at a distance of 65 feet from the center of the roadway. This does not exceed the 65 dB CNEL exterior noise standard and means that noise mitigation will not be required along Renfro Road for lots located farther than 425 feet from the center of the railroad track.

Options for mitigation of noise from transportation noise sources include increasing residential building setbacks from the railroad and Santa Fe Way or the construction of sound walls. It has been assumed that sound walls are the most practical form of noise mitigation for this project. Sound walls will provide acoustical shielding of outdoor activity areas located closest to the noise sources of concern and reduce the amount of noise affecting the interior of proposed residential units.

A sound wall insertion loss program based on the FHWA Model was used to calculate the insertion loss (noise reduction) provided by a sound wall. The model calculates the insertion loss of a wall of given height based on the effective height of the noise source, height of the receiver, distance from the receiver to the wall, and distance from the noise source to the wall. The standard assumptions used in the sound wall calculations for a traffic noise source are effective source heights of 8, 2 and 0 feet above the roadway for heavy trucks, medium trucks and automobiles, respectively. The assumed effective source height for a railroad locomotive and cars is 10 feet above the top of the rails. The standard height of a residential receiver is five feet above the ground elevation. It was assumed that the building pad elevations on the closest proposed lots to Santa Fe Way will be at approximately at the same elevation as the roadway pavement.

Based upon the above-described assumptions and method of analysis, the noise level insertion loss values for sound walls of various heights were calculated. The calculations indicated that a six (6) foot-high sound wall along the eastern frontage of the R-1 development area would reduce traffic and railroad noise exposure within the backyards of the closest lots by 5 dB. This would result in a combined traffic and railroad noise exposure of 61.7 dB CNEL or less which complies with the 65 dB CNEL standard of the noise element. The 6 foot-high sound wall should be turned westward along Renfro Road to acoustically shield the northern side of lots located closer than 425 feet from the center of the railroad track. All sound wall heights are relative to the closest building pad elevations.

For the closest portion of the proposed R-2 development area to the railroad and Santa Fe Way, an eight (8) foot-high sound wall along the Santa Fe Way frontage would reduce traffic and railroad noise exposure by 7.6 dB at a distance of 15 feet inside the wall at the first floor level. The resulting combined traffic and railroad noise exposure would be 64.3 dB CNEL which complies with the 65 dB CNEL standard of the noise element. It is noted that the sound wall would be minimally effective at the second floor level. The sound wall should be turned westward along the northern and southern boundaries of the R-2 development area. The height of those sections of the sound wall may be reduced to six feet.

With regard to stationary noise sources within and adjacent to the project site, existing oil wells and potential M-1 development have the potential to generate noise levels in excess of the noise element standards at the closest noise-sensitive receptors. Figure 1 indicates that existing oil wells are located at several points within the development. The well identified as KAPEG-1 is located within a residential lot within the R-1 development area. Wells KAPEG-2, 3 and 4 and ARCO-34X are located within the M-1 development area and Wells ARCO-35X and ARCO-36X are located within a designated "drill site" within the R-1 development area. There are other non-operating wells or well sites within the R-1 development area as noted on Figure 1.

The noise level data presented in Table V were used as the basis for determining noise mitigation requirements for proposed residential lots near the operating wells. Compliance with the L_{50} nighttime standard for stationary sources was used as the basis for determining noise mitigation requirements. With regard to KPAEG-1, the measured L_{50} at a distance of 50 feet was 62.6 dB. Compliance with the nighttime L_{50} standard of 50 dB would require that noise levels produced by the well be reduced by 12.6 dB. Mitigation could include increasing the distance to the closest residential lots, construction of sound walls, installing an electric motor in place of the existing internal combustion engine or a combination of the above. Assuming a distance of 50 feet between the operating well and closest residential lot, a sound wall with a minimum height of 12 feet above the closest building pad elevation would be required.

Wells KPAEG-2, 3 and 4 and ARCO-34X are located within the M-1 development area. The only one of those wells operating at the time this study was prepared was KAPEG-2. That well generated an L_{50} of 57.7 dB at a distance of 50 feet. The approximate distance from the above-referenced wells within the M-1 area to the closest R-1 lots is 130 feet. Assuming that the noise level measured for KPEG-2 is representative of the other operational wells at that location, the L_{50} at the closest R-1 lots would be 49.4 dB. This complies with the nighttime L_{50} standard of the Noise Element. It is noted that the required sound wall along the eastern side of the R-1 development area for traffic and railroad noise mitigation would further reduce noise levels from the oil wells located within the M-1 development area.

Wells ARCO-35X and ARCO-36X are located within a designated "drill site" surrounded by R-1 residential lots. The measured L_{50} when projected for a reference distance of 50 feet from the wells was 65.2 dB. The estimated distance from the wells the closest R-1 lots within the project is 75 feet. Assuming the normal rate of attenuation over distance for a point noise source, the L_{50} at the closest R-1 lots would be 61.7 dB. Compliance with the nighttime L_{50} 50 dB standard of the noise element would require that an 11 foot-high sound wall be constructed along the west

and north sides of the drill site and that an 8 foot-high sound wall be constructed along the east side of the drill site.

With the exception of the existing oil wells within the area designated for M-I development, the uses that could be developed within the M-1 area were unknown to BBA at the time this study was prepared. M-I uses could include the use of stationary mechanical equipment and/or mobile equipment sources that could generate noise levels in excess of the noise element standards. When specific uses have been identified, noise mitigation should be part of the project design. Mitigation measures could include equipment enclosures, the use of buildings or other structures to acoustically shield nearby R-1 uses or the construction of sound walls higher than previously described for traffic and railroad noise mitigation between M-1 and R-1 uses.

Interior Noise Exposure:

The interior noise level standard of the noise element is 45 dB CNEL for transportation noise sources. Assuming that the exterior noise exposure due to transportation noise sources within the R-1 and R-2 development areas would not exceed 65 dB CNEL after the above-described noise mitigation measures have been implemented, future homes would need to be capable of providing a minimum outdoor-to-indoor noise level reduction (NLR) of 20 dB (65-45=20). It may be assumed that conventional residential construction will provide a minimum NLR of 25 dB provided windows and doors are closed. This is sufficient for compliance with the 45 dB CNEL interior standard for first-floor receivers. Requiring that it be possible for windows and doors to remain closed for sound insulation purposes means that air conditioning or mechanical ventilation will be required.

If second-floor receivers are planned for the R-2 development area, a detailed analysis of the construction should be prepared by a qualified acoustical consultant to determine if the proposed construction may need to incorporate additional noise mitigation measures.

CONCLUSIONS AND RECOMMENDATIONS

The proposed 94.2 acre mixed-use development at Santa Fe Way and Renfro Road will comply with the exterior and interior noise level requirements of the Metropolitan Bakersfield General Plan provided that the following noise mitigation measures are included in the proposed project design.

1. A six (6) foot-high sound wall, relative to the closest building pad elevations, should be constructed along the eastern boundary of the R-1 development area to reduce traffic and railroad noise exposure within the backyards of the closest residential lots. The sound wall should be turned westward along Renfro Road to acoustically shield the northern side of lots located closer than 425 feet from the center of the railroad track.

2. An eight (8) foot-high sound wall, relative to the closest building pad elevations, should be constructed along the Santa Fe Way frontage to reduce traffic and railroad noise exposure within the proposed R-2 development area. The sound wall should be turned westward along the northern and southern boundaries of the R-2 development area. The

height of those sections of the sound wall may be reduced to six feet relative to the closest building pad elevations.

3. If second-floor receivers are planned for the R-2 development area, a detailed analysis of the construction should be prepared by a qualified acoustical consultant to determine if the proposed construction may need to incorporate additional noise mitigation measures.

4. Air conditioning or mechanical ventilation is required for R-1 and R-2 residential uses so that windows and doors may be closed for sound insulation purposes.

5. Attic vent baffles should be installed in all gable vents facing Santa Fe Way and the railroad in the R-2 development area. An example of a suitable attic vent baffle is shown in Appendix B.

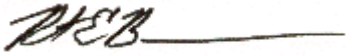
6. A 12 foot-high sound wall, relative to the closest building pad elevations, should be constructed around the KPAG-1 oil well site unless the proposed minimum building setback from the well is increased beyond 50 feet or quieter-technology pumping equipment (i.e. electric motor, etc.) is installed at the well.

7. An 11 foot-high sound wall, relative to the closest building pad elevations, should be constructed along the west and north sides of the designated "drill site" where oil wells ARCO-35X and ARCO-36X are located. An 8 foot-high sound wall should be constructed along the eastern side of the drill site. Required sound wall heights could be reduced if quieter-technology pumping equipment is installed at the wells.

8. Noise mitigation measures should be considered when specific uses within the M-1 development area are proposed. Mitigation measures could include equipment enclosures, the use of buildings or other structures to acoustically shield nearby R-1 uses or the construction of sound walls higher than required for traffic and railroad noise mitigation between M-1 and R-1 uses.

The conclusions and recommendations of this acoustical analysis are based upon the best information known to Brown-Buntin Associates, Inc. (BBA) at the time the analysis was prepared concerning the proposed site plan, project grading and noise sources affecting the project site. Any significant changes in these factors will require a reevaluation of the findings of this report. Additionally, any significant future changes in motor vehicle, railroad or other mechanical equipment technology, noise regulations or other factors beyond BBA's control may result in long-term noise results different from those described by this analysis.

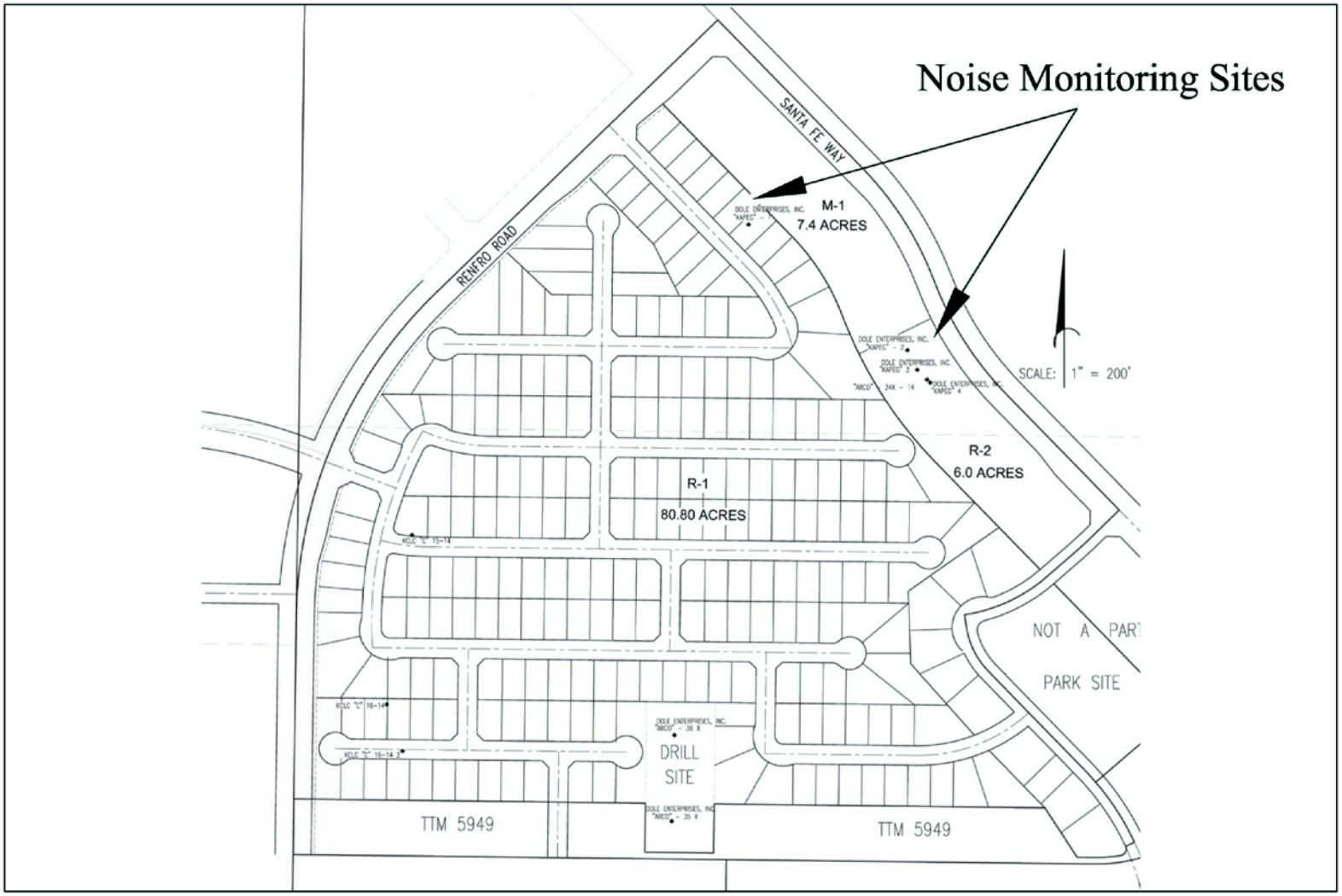
Respectfully submitted,



Robert E. Brown
President

REB:reb

Figure 1: Project Site Plan and Noise Monitoring Site Locations



APPENDIX A

ACOUSTICAL TERMINOLOGY

AMBIENT NOISE LEVEL: The composite of noise from all sources near and far. In this context, the ambient noise level constitutes the normal or existing level of environmental noise at a given location.

CNEL: Community Noise Equivalent Level. The average equivalent sound level during a 24-hour day, obtained after addition of approximately five decibels to sound levels in the evening from 7:00 p.m. to 10:00 p.m. and ten decibels to sound levels in the night before 7:00 a.m. and after 10:00 p.m.

DECIBEL, dB: A unit for describing the amplitude of sound, equal to 20 times the logarithm to the base 10 of the ratio of the pressure of the sound measured to the reference pressure, which is 20 micropascals (20 micronewtons per square meter).

DNL/L_{dn}: Day/Night Average Sound Level. The average equivalent sound level during a 24-hour day, obtained after addition of ten decibels to sound levels in the night after 10:00 p.m. and before 7:00 a.m.

L_{eq}: Equivalent Sound Level. The sound level containing the same total energy as a time varying signal over a given sample period. L_{eq} is typically computed over 1, 8 and 24-hour sample periods.

NOTE: The CNEL and DNL represent daily levels of noise exposure averaged on an annual basis, while L_{eq} represents the average noise exposure for a shorter time period, typically one hour.

L_{max}: The maximum noise level recorded during a noise event.

L_n: The sound level exceeded "n" percent of the time during a sample interval (L_{90}, L_{50}, L_{10}, etc.). For example, L_{10} equals the level exceeded 10 percent of the time.

A-2

ACOUSTICAL TERMINOLOGY

NOISE EXPOSURE CONTOURS: Lines drawn about a noise source indicating constant levels of noise exposure. CNEL and DNL contours are frequently utilized to describe community exposure to noise.

NOISE LEVEL REDUCTION (NLR): The noise reduction between indoor and outdoor environments or between two rooms that is the numerical difference, in decibels, of the average sound pressure levels in those areas or rooms. A measurement of Anoise level reduction@ combines the effect of the transmission loss performance of the structure plus the effect of acoustic absorption present in the receiving room.

SEL or SENEL: Sound Exposure Level or Single Event Noise Exposure Level. The level of noise accumulated during a single noise event, such as an aircraft overflight, with reference to a duration of one second. More specifically, it is the time-integrated A-weighted squared sound pressure for a stated time interval or event, based on a reference pressure of 20 micropascals and a reference duration of one second.

SOUND LEVEL: The sound pressure level in decibels as measured on a sound level meter using the A-weighting filter network. The A-weighting filter de-emphasizes the very low and very high frequency components of the sound in a manner similar to the response of the human ear and gives good correlation with subjective reactions to noise.

SOUND TRANSMISSION CLASS (STC): The single-number rating of sound transmission loss for a construction element (window, door, etc.) over a frequency range where speech intelligibility largely occurs.

APPENDIX B

EXAMPLE OF ATTIC VENT BAFFLE CONSTRUCTION