Appendix CNRP
Construction Noise Reduction Plan

Howard Terminal Athletics Ballpark

Oakland, CA

Construction Noise Reduction Plan

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Prepared for:

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Salter Project Number: 19-0341

1.0 INTRODUCTION

As requested, we performed a review of the construction phasing and equipment plan received on 25 June 2019. The purpose of our review is to provide a noise reduction plan (NRP) in accordance with the standard conditions of approval for noise (SCA-NOI) contained in the project environmental impact report (EIR) for Phase 1 area site preparation and ballpark construction as well as Phase 2 area site preparation. It does not include an analysis of Phase 2 new construction as that is not defined at this time. Our analysis compares the project-related construction activity to the City of Oakland's maximum property line noise level standards and includes a discussion of potential mitigation measures to reduce the impact of construction noise to meet the intent of the City's criteria at adjacent properties.

On-site continuous noise monitoring during construction should also be performed by a qualified acoustical consultant to refine the estimated noise levels and verify that construction noise impacts are reduced at surrounding land-uses.

2.0 CRITERIA

We understand the following criteria are applicable to this project.

2.1 Construction Noise Ordinance

The City of Oakland stipulates maximum allowable noise levels for construction activity to surrounding land uses. Table 1 provides the City's maximum allowable standards for construction noise at the property line of receiving land-uses. As indicated, the standard is dependent on the duration of the construction activity and type of receiving land-use.

Table 1: City of Oakland Maximum Allowable Receiving Noise Standard for Temporary Construction or Demolition Activities (dBA[1])

Operation/Receiving Land Use	Daily 7:00 a.m. to 7:00 p.m.	Weekends 9:00 a.m. to 8:00 p.m.
Short-Term Operation (less than 10 days)		
Residential	80	65
Commercial, Industrial	85	70
Long-Term Operation (more than 10 days)		
Residential	65	55
Commercial, Industrial	70	60

Section 17.120.04.G.2 also states the following for nighttime construction noise.

The nighttime noise level received by any land use and produced by any construction or demolition

[1] A-Weighted Sound Level – The A-weighted sound pressure level, expressed in decibels (dB). Sometimes the unit of sound level is written as dB(A). A weighting is a standard weighting that accounts for the sensitivity of human hearing to the range of audible frequencies. People perceive a 10 dB increase in sound level to be twice as loud. In accordance with Oakland Planning Code Section 17.120.50D, noise levels will be adjusted to the ambient noise level in any circumstance where the ambient noise level exceeds the stated standard.

activity between weekday hours of seven (7) p.m. and seven (7) a.m. or between eight (8) p.m. and nine (9) a.m. on weekends and federal holidays shall not exceed the applicable nighttime noise level standards outlined in this Section.

This would limit nighttime construction noise to a noise level of no more than 45 dBA for a cumulative duration of 20 minutes or more in any hour. Per subsection D of the same section, the limit can be increased to equal the ambient noise levels where it exceeds the standard.

The entire construction project is considered long-term construction per section 17.120.050.G of the Planning Code.

The City of Oakland considers construction noise to have a significant impact on the environment if it would:

- Violate the City of Oakland Noise Ordinance (Oakland Municipal Code Section 8.18.020) regarding nuisance of persistent construction noise, except if an acoustical analysis is performed and all feasible mitigation measures imposed, including the standard City of Oakland measures adopted by the Oakland City Council on January 16, 2001;

While Section 17.120.060 establishes vibration restrictions, there are no applicable restrictions codified that address vibration from construction.

2.2 Environmental Impact Report

The Environmental Impact Report (EIR) for the project also includes mitigation measures. Refer to the EIR document for specific language that would also apply to the project.

Proposed hours/days of construction are as follows:

General Construction Hours
Monday through Friday - 7am to 7pm
Saturday and Sunday - 9am to 5pm

Nighttime Construction Hours
Monday through Friday – 7pm to 7am
Saturday and Sunday – 5pm to 9am

2.4 Ambient Noise Levels

On other similar construction projects, we have also developed noise limits based on the ambient conditions surrounding the site. Hourly L_{eq} noise levels monitored during construction are compared to the typical range of hourly L_{eq} ambient noise levels (i.e., no construction) to see if construction activities exceed typical ambient conditions for the site. We understand that the City will require noise monitoring during construction of this project.

To quantify ambient noise levels surrounding the site we conducted continuous noise measurements at three locations surrounding the project site as shown in Figure 1. The locations were selected to monitor noise levels at noise-sensitive areas adjacent to the subject property that could be affected by construction noise as follows.

Location 1 – South side of Phoenix lofts facing the site

Location 2 – West side of the Port of Oakland offices facing the site
Location 3 – Closest residential neighborhood on the island of Alameda

The measurement duration was two weeks between 21 June 2019 and 9 July 2019. A summary of average and maximum hourly L_{eq} ambient noise levels is shown below in Table 2.

Table 2: Measured Ambient Noise Levels (Hourly Leq, dBA)

Location	Hour	Weekday		Saturday		Sunday	
		Average	Maximum	Average	Maximum	Average	Maximum
Location 1 (L1)	7:00	76	82	77	77	76	76
	8:00	78	82	71	71	77	79
	9:00	77	80	78	79	78	82
	10:00	79	85	78	82	79	80
	11:00	77	82	74	75	79	79
	12:00	77	83	74	79	74	74
	13:00	77	81	76	82	78	82
	14:00	80	85	80	84	80	81
	15:00	79	84	79	80	77	79
	16:00	80	86	82	86	75	84
	17:00	81	85	81	84	79	80
	18:00	79	83	79	79	77	80
Location 2 (L2)	7:00	70	73	72	74	69	73
	8:00	74	79	70	73	69	70
	9:00	73	79	68	70	70	73
	10:00	73	80	74	76	71	72
	11:00	71	74	73	75	73	74
	12:00	69	73	68	68	68	71
	13:00	73	77	70	71	69	70
	14:00	73	78	71	72	71	71
	15:00	71	76	73	75	75	76
	16:00	71	77	68	72	66	70
	17:00	75	78	74	74	73	75
	18:00	73	76	72	73	74	75
Location 3 (L3)	7:00	57	61	50	50	48	50
	8:00	59	66	51	52	48	49
	9:00	58	62	51	52	51	51
	10:00	60	67	51	52	50	50
	11:00	58	61	52	53	51	51
	12:00	60	72	52	53	50	52
	13:00	61	73	51	54	50	51
	14:00	59	67	50	51	49	50
	15:00	58	62	55	59	50	51

Table 2: Measured Ambient Noise Levels (Hourly Leq, dBA)							
Location	Hour	Weekday		Saturday		Sunday	
		Average	Maximum	Average	Maximum	Average	Maximum
	16:00	55	62	50	51	49	50
	17:00	53	58	53	56	51	52
	18:00	53	61	50	51	50	50

We understand that nighttime construction may also be performed; therefore, we have included ambient noise data for nighttime hours as well. Only residential receivers at the Phoenix lofts and Alameda Landing area near locations L1 and L3 would be subject to nighttime construction noise. The Port of Oakland office Building at location L2 would not be occupied during these times. Table 3 below summarizes the measured nighttime ambient noise levels.

Table 3: Measured Ambient Nighttime Noise Levels (Hourly Leq, dBA)							
Location	Hour	Weekday		Saturday		Sunday	
		Average	Maximum	Average	Maximum	Average	Maximum
Location 1 (L1)	19:00	77	85	77	77	76	80
	20:00	79	84	74	74	70	71
	21:00	67	81	73	73	74	77
	22:00	75	83	75	75	73	82
	23:00	71	78	52	52	59	67
	0:00	74	80	81	81	73	78
	1:00	63	79	59	59	53	54
	2:00	56	74	61	61	51	51
	3:00	59	78	60	60	52	53
	4:00	73	81	69	69	69	75
	5:00	74	81	79	79	69	74
	6:00	74	81	63	63	64	76
Location 3 (L3)	19:00	53	53	51	52	51	51
	20:00	53	53	51	52	50	51
	21:00	50	50	50	51	50	52
	22:00	49	49	50	52	48	49
	23:00	48	48	49	49	47	49
	0:00	46	46	47	48	47	48
	1:00	44	44	44	45	47	48
	2:00	44	44	44	44	46	49
	3:00	44	44	44	44	46	47
	4:00	46	46	43	44	45	45
	5:00	51	51	46	46	47	48
	6:00	55	55	51	57	50	54

Furthermore, monitoring locations L1 and L2 are in close proximity to the railroad right of way with significant Amtrak and freight operations. Train pass by these locations sounding their horn, which generates significant noise levels as identified in Table 4 below.

Table 4: Measured Single-Event Noise Levels		
Location	**Typical Single Event Noise Level ($L_{max}30$[2]-dBA)**	**Maximum Measured Noise Level (dBA)**
L1	114	115
L2	105	108
L3	89	93

3.0 CONSTRUCTION SCHEDULE AND EQUIPMENT

The construction noise analysis contained in this report includes the construction of the ballpark and associated site infrastructure only and is expected to be phased as follows:

- Phase 1 Area Demolition (Ballpark and Initial Ancillary Development Area) – 14 months
- Phase 2 Area Demolition (Additional Ancillary Development Area) – 3 months
- Rapid Impact Compaction of Site – 6 months
- Phase 1 Grading and Site Preparation – 8 months
- Phase 1 Site Utilities – 6 months
- Phase 1 Ballpark Building Construction – 24 months
- Phase 1 Paving – 3 months
- Phase 1 Ballpark Architectural Coating – 21 months

Various pieces of construction equipment will be used during construction as follows:

Demolition Equipment

- Concrete/Industrial Saws
- Excavators
- Tractors/Loaders/Backhoes
- Crushing and Processing Equipment
- Hoe Ram

Rapid Impact Compaction

- Excavators with Hammers
- Water Trucks

[2] L_{max30} (Typical Maximum Sound Level) – There is no standardized metric to quantify "typical" maximum sound levels in an environment (instead of the absolute maximum sound level for a measurement period). The metric L_{max30} comes from a paper by Rob Greene ("Max Level Intrusive Noise Limit: 1982 National Conference on Environmental and Occupational Noise"). It is based on the logarithmic average of the noisiest 30 percent of single events (e.g., train passbys, aircraft flyovers).

Deep Dynamic Compaction (DDC) and Deep Power Compaction (DPC) may also be utilized, however, these activities generate lower noise levels. Therefore, we are conservatively assuming the use of RIC with respect to the noise analysis.

Grading and Site Preparation

- Tractors/Loaders/Backhoes
- Scrapers/Blades/Rollers
- Water Trucks
- Generators

Site Utilities

- Excavators
- Tractors/Loaders/Backhoes
- Water Trucks

Ballpark Building Construction

- Pile Driving Rigs (up to 3 operating simultaneously)
- Forklifts
- Concrete Pump
- Bobcat
- Small and Large Excavators
- Cranes
- Cutting/chopping saws
- Air compressors
- Powder Actuated Guns
- Water Truck
- Generator

Paving

- Water Trucks
- Pavers
- Rollers

Ballpark Architectural Coating

- Air compressors
- Mobile cranes
- Forklifts

Per the proposed construction equipment list, Table 5 below indicates the expected equipment noise levels. These noise levels are the basis of our analysis.

Table 5: Typical Noise Levels Used for the Analysis[3]	
Equipment	**Noise Level (dBA) @ 50 Feet**
Earthmoving	
Front Loader	79
Backhoe	85
Dozer	80
Tractor	80
Scraper	89
Grader	85
Paver	89
Roller	74
Trucks	84
Stationary	
Air Compressor	81
Generator	81
Concrete Mixer	85
Concrete Pump	82
Crane	88
Impact	
Pneumatic Tools	86
Impact Pile Driver	101
Jack Hammer	88
Rapid Impact Compactor (Excavator with Hammer)	80 to 84[4]
Other	
Hoe Ram	90
Vibrator	76
Saw	76

3 Based on the US EPA document, "Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances" (1971), noise data from Federal Highway Administration (FHWA), and data from other CSA projects.

4 Rapid Impact Compactor – An Innovative Dynamic Compaction Device for Soil Improvement, Dietmar, Paulmichl, – Improvement of Soil Properties, Bratislava on June 4-5, 2007

Based on the construction equipment noise levels above, the loudest pieces of equipment for each phase of construction are as shown in Table 6.

Table 6: Loudest Piece of Construction Equipment per Phase		
Phase	**Equipment**	**Noise Levels (dBA at 50-ft)**
Demolition	Hoe Ram	90
Rapid Impact Compaction	Excavator with Hammer	84
Grading and Site Preparation	Scraper	89
Site Utilities	Backhoe	85
Ballpark Building Construction	Impact Pile Driver	101
Paving	Paver	89
Ballpark Architectural Coating	Crane	88

4.0 CONSTRUCTION NOISE

Based on our review of the phasing and equipment plan prepared by the contractor and noise levels for various equipment (see Table 5), we calculated noise levels at nearby receiver locations using the Federal Highway Administration Roadway Construction Noise Model (RCNM) methodology for the loudest piece of construction equipment used in the corresponding phase. For the purposes of this report, we analyzed noise levels at the long-term monitoring locations (see section 2.4 and Figure 1).

4.1 Location 1

This location is on the northern side of the railroad right of way adjacent to the Phoenix Lofts. It is located approximately 350-ft north of the future ballpark. Based on the construction equipment information provided by the contractor, we estimate that construction noise levels at this location, without mitigation, could be up to those shown in Table 7 below.

Table 7: Construction Noise Analysis for Location 1 (without mitigation)					
Phase	**Estimated Maximum Construction Noise Levels (Hourly L_{eq}, dBA)**	**Measured Ambient Noise Level During Construction Hours (Hourly L_{eq}, dBA)**			
		Weekday		**Weekend**	
		Average	**Maximum**	**Average**	**Maximum**
Demolition	73	76 to 81	86	71 to 82	86
Rapid Impact Compaction	78				
Grading and Site Preparation	83				
Site Utilities	79				
Ballpark Building Construction	85				
Paving	83				
Ballpark Architectural Coating	71				

4.2 Location 2

This location is on the west side of the Port of Oakland office building along Clay Street south of Embarcadero West. It is located approximately 650-ft east of the future ballpark. Based on the equipment information provided by the contractor, we estimate that construction noise levels at this location, without mitigation, could be up to those shown in Table 8 below.

Table 8: Construction Noise Analysis for Location 2 (without mitigation)

Phase	Estimated Maximum Construction Noise Levels (Hourly L_{eq}, dBA)	Measured Ambient Noise Level During Construction Hours (Hourly L_{eq}, dBA)			
		Weekday		Weekend	
		Average	Maximum	Average	Maximum
Demolition	83	69 to 75	80	66 to 74	76
Rapid Impact Compaction	65				
Grading and Site Preparation	83				
Site Utilities	67				
Ballpark Building Construction	78				
Paving	65				
Ballpark Architectural Coating	66				

4.3 Location 3

This location is on the island of Alameda near residences along Mitchell Avenue. It is located approximately 1,700-ft south of the future ballpark across the Oakland Inner Harbor. Based on the equipment information provided by the contractor, we estimate that construction noise levels at this location, without mitigation, could be up to those shown in Table 9 below. It should be noted that this noise level would only occur when exposed to residences through existing structures between the ballpark and residences on Alameda Island. Additional noise reduction of approximately 5 to 15 dBA would be realized when there is no direct line-of-sight to noise generating activities.

Table 9: Construction Noise Analysis for Location 3 (without mitigation)

Phase	Estimated Maximum Construction Noise Levels (Hourly L_{eq}, dBA)	Measured Ambient Noise Level During Construction Hours (Hourly L_{eq}, dBA)			
		Weekday		Weekend	
		Average	Maximum	Average	Maximum
Demolition	59	52 to 58	73	48 to 55	59
Rapid Impact Compaction	53				
Grading and Site Preparation	58				
Site Utilities	54				
Ballpark Building Construction	70				
Paving	58				
Ballpark Architectural Coating	57				

4.4 Nighttime Construction Noise

It is expected that nighttime construction may be necessary due to the construction schedule and activities (e.g., concrete pouring). The specific activities anticipated are as follows.

- Surveying
- Mass excavation/grading and soil import/export
- Underslab utilities
- Concrete pouring (at-grade and above-grade metal deck)
- MEPS deck inserts
- Precast stadia erection
- Specialty steel erection
- Exterior painting and coatings
- Exterior sitework

Based on the above activities, the loudest noise would be expected to occur during mass excavation as well as steel work. Mass excavation could occur as close as 115-ft to location L1, however, steel work would be expected to be limited to the stadium footprint, approximately 375-ft away. Estimate nighttime construction noise levels at locations L1 and L3 are shown below in Table 10.

Table 10: Nighttime Construction Noise Levels

Phase	Estimated Maximum Nighttime Construction Noise Levels (Hourly L_{eq}, dBA)		Measured Ambient Noise Level During Nighttime Hours (Hourly L_{eq}, dBA)			
			Location L1		Location L3	
	Location L1	Location L3	Average	Maximum	Average	Maximum
Mass Excavation	83	58	51 to 81	85	43 to 55	57
Steel Work[5]	69	56				

As indicated in Table 10, nighttime construction activities would be expected to exceed 45 dBA and the average ambient noise level but could be approximately equal to the maximum measured ambient noise level. Some activities may need to be limited depending on the resulting noise levels. Measurements of these or similar activities during daytime hours could also be used to determine potential noise impacts of nighttime construction activities.

5.0 CONSTRUCTION NOISE REDUCTION PLAN RECOMMENDATIONS

As indicated in the previous section, maximum estimated construction noise levels could exceed average ambient noise levels, however, they are expected to be at or near the maximum measured hourly L_{eq} noise level at all locations. Furthermore, estimated construction noise levels at location L1 and L2 are significantly below the typical single-event noise levels generated by trains passing the site. Noise levels at location L3 are expected to meet the City of Oakland Construction Noise Ordinance for long-term operation with the possible exception of pile driving activities where there is direct line-of-sight. At location L2, this building would not be expected to be occupied during the weekend.

[5] Source: Charles M. Salter Associates, Inc. field measurements, Kaiser Oakland, 2010. Assumes noise levels of 79 dBA at 125-ft

The specific noise level during construction could vary and will depend on the duration and location of use for each piece of equipment. The noise levels above represent an estimated worst-case scenario of a piece of equipment being operated continuously for 60 minutes at the edge of the site closest to the measurement location, which is unlikely. Noise levels will be monitored during construction to refine these estimates and corresponding mitigation measures as necessary.

5.1 Noise Reduction Measures

1. **Schedule**: Loud activities such as rock breaking and pile driving are to occur between 8am and 4pm, every day (pile driving to start at 9am on weekends). Similarly, other activities that can potentially create extreme noise levels above 90 dBA are to be avoided where possible. Where such activities cannot be avoided they are to also occur between 8am and 4pm.

2. **Site Perimeter Barrier:** To reduce noise levels, a 10-ft high noise barrier should be constructed on the northern and eastern edges of the site as shown in Figure 1.

   Barriers should either be constructed with two layers of ½-inch thick plywood (joints staggered), and K-rail or other support; or a limp mass barrier material weighing two pounds per square foot such as Kinetics KNM-200B or equivalent.

   If noise levels prove to be too loud during construction at other locations, the location of the barrier could be expanded to include other portions of the project.

3. **Stationary Equipment Local Barriers**: If needed, provide additional localized barriers around stationary equipment such as air compressors that break line-of-sight to neighboring properties.

4. **Generators**: Locate generators far away from noise-sensitive receivers, as feasible. If necessary, generator noise could be reduced by providing sound-rated enclosures and exhaust mufflers or by providing a local noise barrier.

5. **Construction Equipment:** Where necessary, provide exhaust mufflers on pneumatic tools. All equipment should be properly maintained.

6. **Truck Traffic**: Minimize truck idling and require trucks to load and unload materials in the construction areas, as opposed to idling on local streets. If truck staging is required, locate the staging area along major roadways with higher traffic noise levels or away from the noise-sensitive receivers such as Embarcadero West and internal to the project.

7. **Methods:** Consider means to reduce the use of heavy impact tools and locate these activities away from the property line as feasible. Other methods, including drilling, could be employed if noise levels are found to be excessive. Piles could be pre-drilled as feasible and a wood block placed between the hammer and pile to reduce metal to metal contact noise and "ringing" of the pile.

8. **Noise Complaint Liaison:** Establish a noise complaint liaison that will field complaints regarding construction noise and interface with the construction team. Distribute contact information to nearby noise-sensitive receivers (e.g., Phoenix Lofts and Port of Oakland offices). Post signs including contact information at the construction site. A complaint log will be kept by the liaison.

9. **Notification and Confirmation**: Notify neighbors of extreme noise generating activities including the estimated duration of the activity, construction hours, and contact information a minimum of two weeks prior to the scheduled activity.

10. **Nighttime Construction**: If monitoring confirms nighttime construction activities significantly exceeds the ambient noise level and regularly occurring complaints occur additional mitigation such as additional storm windows installed in specific residences and/or additional local barriers could be constructed. The specific approach would be refined as the construction activities and noise levels are refined.

5.2 Construction Noise Monitoring Reports

As part of ongoing construction noise monitoring for the project, monthly reports will be prepared and sent to the contractor to be forwarded to Inspection Services staff no more than two weeks from the end of the noise assessment period being reported. The report will detail hourly L_{eq} noise levels during construction hours and a comparison to the ambient baseline noise measurements conducted prior to construction. Furthermore, extreme noise generating events above 90 dBA will be documented. Attempts will be made to identify the source of any noise, which causes an exceedance of the standards.

Since specific noise levels at adjacent noise-sensitive properties will depend on the location of construction activities within the site, bi-weekly site visits will be conducted in addition to continuous noise monitoring. Additional specific mitigation measures can be developed as needed based on the results of the monitoring throughout the construction of the project to meet the intent of the City's criteria (see section 2 above).

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HOWARD TERMINAL ATHLETICS BALLPARK MEASUREMENT LOCATIONS AND MEASURED NOISE LEVELS

FIGURE 1

Salter #	AKS
19-0341	08.01.19