SECTION F: MIT Kendall Square Acoustical Study



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Ms. Sandra Smith, AIA, LEED AP Perkins+Will 225 Franklin Street, Suite 1100 Boston, MA 02110

Via email: <u>sandra.smith@perkinswill.com</u>

Subject: Article 19 Noise Mitigation Narrative MIT Investment Management Company/MIT SoMa and NoMa Site Environmental Noise Evaluation and Compliance Cambridge, MA Acentech Project No. 626051

Dear Ms. Smith:

We present you the MIT and MITIMCo South of Main (SoMa) and North of Main (NoMa) Noise Mitigation Narrative as a part of the Article 19 submission for the City of Cambridge. A final compliance for noise will be reviewed and confirmed as the various projects develop.

INTRODUCTION

The following is a list of the building sites for SoMa and NoMa as part of this study, also shown in the figure on the following page:

- Site 1 This will be a residential tower with ground floor retail space designed by Elkus | Manfredi (MIT)
- Site 2 This will be a future laboratory tower to be designed by Elkus | Manfredi (MITIMCo)
- Site 3 This will be a new laboratory/office tower designed by Perkins + Will (MITIMCo)
- Site 4 This will be a mixed-use Retail/Office/Residential tower and some renovation of the existing E38 and E39 buildings designed by Perkins + Will and NAADA (MIT); a mostly underground parking garage designed by Perkins + Will (MITIMCo), which will connect the various SoMa sites, is adjacent to the south side of Site 4
- Site 5 This will be a commercial office building that will include space for the MIT Museum and retail space on the lower floors designed by Weiss/Manfredi (MIT)
- Site 6 This will be a building used for Retail/Office designed by nArchitects (MITIMCo)



Acentech has reviewed project information from all of the different design teams, conducted a series of ambient sound measurements, and estimated property line and off-site sound levels associated with the proposed equipment. The pertinent findings of our study are summarized in this letter report.

Figures 1-S1 through 1-S6 show the preliminary design layout for each building and the locations of the major sound sources.

EXISTING ACOUSTIC ENVIRONMENT

The figure below is an aerial photograph that shows the SoMa and NoMa project and surrounding community areas.





There are two hotels and one residential tower that we are aware of adjacent to the SoMa and NoMa sites. One hotel is north of Site 4 and another hotel is located between Sites 5 and 6. A residential tower is located north of Site 1. In April and May of 2015, we collected continuous ambient sound data during nominal one week periods at four locations and obtained short-term sound data during nighttime surveys at ten additional locations.

The purpose of the ambient survey was to characterize the existing land uses, sound sources, and acoustic environment in the area. The long-term measurements demonstrated the variation in the ambient sound levels over the day and night hours of weekday and weekend periods. In addition, we conducted short-term ambient sound measurements and observations on two weeknights as part of the overall April/May 2015 survey. Table 1 attached to the end of this narrative lists the instruments that we employed for the ambient measurements. Each sound monitor was laboratory-calibrated within the past year and each instrument's calibration was checked in the field with an acoustic calibrator before and after the measurements. The microphone for each instrument was fitted with a windscreen and mounted at a height of about four to five feet above the ground or roof location. Weather conditions during the overall survey period from 24 April to 14 May 2015 were quite variable with day and night temperatures ranging from about 40°F to above 85°F, periods of calm to moderately high winds, and a few periods of light rain. Although there was construction along Main Street during the weekdays, we judge that, in general, the sound data and observations collected during our survey characterize the typical existing acoustic environment in the area.

Zoning in this area is complex; the following figure shows the published Cambridge zoning map for the area. All "C" zoned areas are considered residential and all "O" zoned areas are offices. "ASD" is a part of Ames Street District, which is a mixed-use development area. For the purpose of our study, our recommendations base the hotels and residential tower as "residential" per the City of Cambridge Noise Ordinance. All other properties are considered "Business".



LONG-TERM DATA

The long-term collected sound data show the hour-to-hour and day-to-day variations in the background sound levels in the area and the short-term data characterize the background acoustic environment during typically quieter times. The main areas of interest are toward the Marriott Residences Hotel north of SoMa and the Kendall Hotel between Sites 5 and 6. The Watermark residential tower located north of NoMa is another property of interest. A MIT residential building is south of the SoMa site but much farther away along Memorial Drive. Other land uses in the area include: office towers north of SoMa; office and lab buildings northwest and west of SoMa; and MIT academic buildings west, south, and east of SoMa.



Figure 2 identifies the four locations selected for the collection of representative long-term ambient sound data. The long-term monitoring locations, which were selected based on their accessibility as well as their proximity to the project areas and potential noise sensitive community receptors, are:

- Location A -- Low roof of Badger Building (One Broadway) next to future Site 1
- Location B -- Lawn around Eastgate (on grade) at Site 2
- Location C -- Roof of MIT Coop across Main Street from Sites 4, 5, and 6
- Location D -- Low roof between Mudd Building and Whitaker College close to Sites 5 and 6

Figures 3a, 3b, 3c, and 3d show the L1, Leq, and L90 A-weighted sound levels for each 10-minute interval over the survey at the four long-term monitoring locations. These figures indicate a wide range of sound levels at the four locations, with the highest and lowest levels typically measured, respectively, during the day and night. The Leq sound levels include both the steady background sounds (e.g., distant traffic, distant construction, building HVAC systems) plus the short-term intrusive sounds (e.g., local car passbys). The L1 sound levels represent the nominal maximum sounds (e.g., local car passbys or sirens) that must occur for at least 1% of each interval (i.e., six seconds of each 10-minute interval). The L90 sound levels characterize the lowest background, or residual sound level that is exceeded for 90% of the time of each interval (i.e., 9 minutes of each 10-minute interval). The L90 sound level cocurs when short-term intrusive sound sources, such as local traffic passbys, are absent and the sound level returns to a lower residual value. During this survey, the L90 sound levels were typically controlled by sounds of distant road traffic and modest to moderate contributions of sounds from the existing nearby commercial buildings. The four figures indicate that the lowest sound levels of about 52 to 56 dBA typically occurred at night.

SHORT-TERM DATA

In addition to long-term sound data, we performed manual short-term sampling of the overall A-weighted sound levels and spectral levels, and observed sound sources during two nighttime periods at each of the 10 locations shown in Figure 4 attached. The sound data were measured over a 10-minute period at each location with a precision sound level meter. The primary sound sources observed at these locations include: local traffic and existing mechanical equipment from the commercial buildings in the surrounding area. Sound from a water sprinkler system was also noted at one location on one night. Table 2 summarizes the residual (L90) ambient sound levels that were measured at each location. As noted above, the L90 level is the value exceeded for nine of the 10-minute sampling period at a location and represents the background, or residual, sound level. The data in Table 2 and Figure 5 indicate residual ambient sound levels ranging from 54 to 61 dBA on the first night and from 50 to 57 dBA on the second night over the 10 locations. As Figure 5 illustrates, the measured residual levels are greater than the residential nighttime standard and less than the commercial anytime standard in the Cambridge Noise Ordinance.

SOUND CRITERIA AND SUGGESTED OVERALL PROJECT SOUND GOALS

During the permitting phase it is necessary to determine the degree of sound reduction required. This is based upon estimates of the sound that will propagate from the facility and the sound level criteria appropriate for the neighborhood. The sound criteria for this project will address the following factors:

- Ambient or background sound levels during the quieter times
- Type of neighborhood residential, business, or industrial
- Character of sound generated by proposed facility sound level and spectrum

EXISTING LOCAL AND STATE NOISE REQUIREMENTS

Depending on the major equipment and noise control selected for a project, a typical emergency generator facility can emit tonal and/or broadband sounds, low frequency sound, and steady and/or intermittent sounds that are noticeable in the community. The City of Cambridge and the MassDEP have noise requirements that protect residents from excessive sound. These requirements are:



LOCAL CAMBRIDGE NOISE REQUIREMENTS

We understand from the City of Cambridge that the emergency generator noise emissions from each building do not need to be included as part of the noise emissions study. The emergency generators for this project are exempt from this ordinance, as long as they are tested during the daytime hours. We will provide appropriate generator noise control measures to meet the MassDEP Noise Guidelines. All mechanical equipment components for each of the sites listed in this report will need to meet the Chapter 8.16, NOISE CONTROL of the City of Cambridge Code of Ordinances. This includes cooling towers, air handling units, exhaust fans, and all mechanical room louver openings.

Under City of Cambridge Zoning Ordinance Article 19 for Planning & Urban Design, the article has requirements to submit a Noise Mitigation Narrative. This article also references the City of Cambridge noise ordinance as discussed above.

STATE MASSDEP NOISE GUIDELINES

The Commonwealth of Massachusetts has enacted regulations for the control of air pollution (310 CMR 7.10). To enforce these regulations, The Massachusetts Department of Environmental Protection (MassDEP) has issued guidelines that limit the level of industrial noise in inhabited areas as follows: a) not to increase the residual ambient sound level by more than 10 dBA and b) not to produce a pure tone condition where the sound pressure level in one octave band exceeds the levels in the two adjacent octave bands by 3 dB or more. The residual ambient sound level may be defined for the purpose of these guidelines as the measurement of the L90 level over the time period of concern or by other means acceptable to MassDEP. In addition, MassDEP typically applies these guidelines both at the property line and at the nearest inhabited residences, with most concern at the residence. No other project noise criteria have been provided to us for consideration.

Based on our discussions with the City of Cambridge, we understand that emergency generators in a commercial area with no residences nearby do not need to meet the daytime and nighttime noise regulation due to the emergency nature. However, the generators must only be tested during the daytime hours. The generator must still adhere to the MassDEP noise guidelines. Based on the MassDEP guidelines and the results of our ambient sound survey, we suggest the following sound goals for the emergency generators:

- No significant tonal sounds at community residences; and
- 60 dBA maximum sound level at the community residences

LOADING DOCK NOISE

A preliminary study has been conducted by the design team regarding the location of the loading docks and truck paths in the SoMa and NoMa project areas. The loading docks are shown in gray for each building on Figure 6 attached. Most of the loading dock areas are partially enclosed within the respective buildings, reducing the likelihood of noise impact to the residences. The loading dock for Site 5, which is adjacent the Kendall Hotel, will be provided with a solid screen on the east side of the loading dock. When the trucks are idle, they will be required to shut off their engine for loading and unloading. The loading dock for Site 1 will face Main Street and would not interfere with the residences at Watermark north of Site 1. All deliveries will occur between 9AM and 9PM as agreed under the City of Cambridge Noise Ordinance, limiting truck noise during the nighttime hours.

OPERATION SOUND AND MITIGATION MEASURES

Based on the equipment layout shown in Figures 1-S1 through 1-S6, abatement methods to be employed to control the sound of the SoMa and NoMa project will include the following:

Site 1

The design team for Site 1 will provide the following:

- Solid acoustical barrier around the cooling towers
- Visual screen around the emergency generator as required by Article 19



- Acoustical enclosure around the emergency generator to meet the MassDEP noise limit
- Generator exhaust pipe will be outfitted with 'critical hospital' grade muffler
- Mechanical penthouses will enclose the major mechanical equipment, with louvers and roof openings outfitted with sound attenuators where needed to mitigate sound to the exterior
- All lower level mechanical room louvers, if any, will be provided with sound attenuators where needed
- Garage exhaust fans, if any, will be provided with sound attenuators where needed to mitigate sound to the exterior

Sites 2 and 3

The design teams for Sites 2 and 3 will provide the following, which will be confirmed once design is more established. The following mitigation measures are based on the building systems initially designed for Site 3:

- Solid acoustical barrier around cooling towers
- Sound attenuators outfitted for the discharge and intake openings of all rooftop lab exhaust fans, visual screens provided as required by Article 19
- Mechanical penthouse enclosing the chillers, boilers, pumps, and air handling units, with louvers and roof openings outfitted with sound attenuators where needed to mitigate sound to the exterior

Site 4

The design team for Site 4 will provide the following:

- All lower level mechanical rooms will be provided with sound attenuators where needed at the louvers
- All residential tower mechanical rooms will be provided with sound attenuators where needed at the louvers
- Solid acoustical barrier around all outdoor equipment on the lower roof and higher roof
- Emergency generator will be provided with an acoustic enclosure to meet the MassDEP noise limit
- Generator exhaust pipe will be outfitted with 'critical hospital' grade muffler
- Visual screen around the emergency generator as required by Article 19
- Garage ventilation fans will be provided with sound attenuators

Site 5

The design team for Site 5 will provide the following:

- Solid acoustical barrier around cooling towers and exhaust fans
- Sound attenuators outfitted for all rooftop exhaust fans
- Mechanical penthouse enclosing the chillers, boilers, pumps, and air handling units, with louvers and roof openings outfitted with sound attenuators to mitigate sound to the exterior
- Emergency generator will be provided with an acoustic enclosure to meet the MassDEP noise limit
- Generator exhaust pipe will be outfitted with 'critical hospital' grade muffler
- Visual screen around the emergency generator as required by Article 19



• All ground level mechanical room louvers will be provided with sound attenuators where needed

Site 6

The design team for Site 6 will provide the following:

- Air cooled condenser units and air handling units will be located within a mechanical well, with sound absorptive finishes on the inside face of the mechanical well
- Air cooled condenser units with inlet and discharge sound attenuators will be provided
- The air handling unit will be provided with sound attenuators at the outside air opening and the exhaust air opening

The sound emissions from emergency generators for SoMa and NoMa will be specified to address compliance with the MassDEP noise guidelines and City of Cambridge Noise Standards. Table 3 presents the initial sound estimates for the project-only equipment at representative community locations, which include both residential and commercial areas. These estimates are based on information provided us on the equipment that will operate continuously (24/7 operation) and on the recommended noise specification values. Table 4 presents similar information as Table 3, but the estimated total sound levels include the contributions of both the project equipment sound and the average ambient sound that we measured on the quieter second night in the community across Locations 1 - 10. The estimates, which are based on current project information, address compliance with the applicable noise requirements.

I trust that this letter provides a useful summary of our study. Should you have any questions regarding our study or this report, please call me at 617-499-8018.

Sincerely yours,

James D. Barnes, P.E.

Acentech Incorporated

Figures 1 to 6 Tables 1 to 4

cc: Rose Mary Su – Acentech



Figure 1-S1. Preliminary Layout of Generator and Mechanical Equipment (Site 1).

ROOF LEVEL





Figure 1-S1 (Con't). Preliminary Layout of Generator and Mechanical Equipment (Site 1).

ROOF AND PENTHOUSE LEVEL





Figure 1-S2. Preliminary Layout of Generator and Mechanical Equipment (Site 2).

No information is available for this building at this time. The building for Site 2 is modeled as a building that is similar to Site 3.



ROOF LEVEL





Figure 1-S3 (Con't). Preliminary Layout of Generator and Mechanical Equipment (Site 3).

PENTHOUSE LEVEL 2





Figure 1-S3 (Con't). Preliminary Layout of Generator and Mechanical Equipment (Site 3).

PENTHOUSE LEVEL 1







Figure 1-S4. Preliminary Layout of Generator and Mechanical Equipment (Site 4).

Equipment list on this level:



Figure 1-S4 (Con't). Preliminary Layout of Garage Level Mechanical Equipment (South Side of Site 4).

GROUND FLOOR







Figure 1-S5. Preliminary Layout of Generator and Mechanical Equipment (Site 5).



Figure 1-S6. Preliminary Layout of Mechanical Equipment (Site 6).



Equipment list on this level: - Air cooled condenser units - Energy recovery unit



Figure 2. Aerial Photo Showing General Areas of Kendall SoMa/NoMa and Long-Term Sound Measurement Locations A to D (April/May 2015 Survey).







Figure 3a. L1, Leq, and L90 Sound Levels Measured for 10-Minute Intervals at Monitoring Location A (4 to 11 May 2015).

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Figure 3b. L1, Leq, and L90 Sound Levels Measured for 10-Minute Intervals at Monitoring Location B (24 April to 1 May 2015).







Day and Time









Figure 4. Aerial Photo Showing General Area of Kendall SoMa/NoMa and Short-Term Sound Measurement Locations 1 to 10 (April/May 2015 Survey).







Figure 5. Range of Short-Term Sound Measurements Obtained during Two Nights (4-5 May and 13-14 May 2015) at Locations 1 to 10 and Cambridge Residential and Commercial Noise Standards.

Octave Band Center Frequency (Hz)





Figure 6. Loading Dock Study (shown in gray).



Table 1. Type of Acoustic Instrumentation Used for Ambient Sound Measurements during April/May2015 Survey.

SHORT-TERM MEASUREMENTS

Instrument Type	Manufacturer	Model
Sound Level Meter	Rion	NA-28
Preamplifier	Rion	NH-23
1/2" Microphone	Rion	UC-59
Acoustic Calibrator	Norsonic	1251

LONG-TERM MEASUREMENTS

Instrument Type	Manufacturer	Model
Sound Level Meter	Rion	NI -52
Preamplifier	Rion	NH-25
1/2" Microphone	Rion	UC-59
Acoustic Calibrator	Gen Rad	1987



	Octave Band Center Frequency (Hz)										
Location	31.5	63	125	250	500	1000	2000	4000	8000	Overall dBA	
		Nighttime Ambient (5/4-5/2015 11:10pm - 1:10am)									
1	64	61	64	64	59	52	42	35	23	61	
2	62	61	63	59	54	47	40	30	17	56	
3	62	63	62	58	54	50	44	33	21	56	
4	64	64	63	61	56	53	47	37	25	59	
5	62	60	60	55	51	49	43	32	20	54	
6	65	62	61	57	51	47	40	33	22	54	
7	62	62	61	56	52	48	42	33	18	54	
8	63	63	62	57	53	49	43	32	19	55	
9	62	62	61	56	53	49	43	33	18	55	
10	59	60	60	57	51	48	43	33	17	54	
		Night	time An	nbient (5	5/13-14/20	015 11:00	pm - 1:10a	am)			
1	60	59	58	57	52	47	39	28	16	54	
2	60	59	58	53	48	44	36	28	16	50	
3	62	61	60	58	53	49	43	31	16	55	
4	64	63	61	60	54	51	46	36	24	57	
5	63	62	62	57	51	48	41	30	17	54	
6	60	59	58	53	50	46	39	28	17	52	
7	59	60	59	54	50	47	40	35	42	53	
8	60	60	59	54	51	48	42	32	18	53	
9	58	59	58	56	51	47	41	35	20	53	
10	62	63	61	56	53	49	43	34	21	55	

Table 2. Summary of Short-Term Residual (L90) Sound Measurements Obtained during Two Nights(4-5 May and 13-14 May 2015) at Locations 1 to 10.

Data obtained for 10-minute period at each street level location with a hand-held sound level meter.



Table 3. Estimates of Project-Only Sound Pressure Levels and Overall A-Weighted Sound Levels at Community Locations Compared with Average Measured Nighttime Ambient Sound Levels and City of Cambridge Noise Standards.

	Octave Band Center Frequency (Hz)									
Location	31.5	63	125	250	500	1000	2000	4000	8000	Overall dBA
Watermark Condos-elevated (west bldg)	46	47	46	43	42	39	33	27	14	44
100 Memorial Drive Apts (elevated)	43	45	44	39	34	30	25	18	2	37
Marriott Hotel (elevated)	46	49	47	45	41	39	33	26	12	44
Kendall Hotel (elevated)	56	60	55	42	34	26	26	25	22	42
1	42	43	42	38	32	28	23	16	-2	35
2	47	47	49	43	46	42	34	26	18	46
3	44	46	46	42	39	35	29	23	12	40
4	48	48	47	40	42	39	30	23	13	43
5	42	44	43	39	36	34	25	17	2	38
6	47	50	49	44	37	33	30	26	16	41
7	40	41	39	35	30	25	20	14	-1	32
8	41	43	42	37	34	31	24	17	5	36
9	41	42	38	31	27	24	18	8	-8	30
10	45	46	39	30	24	20	14	6	-4	29
		Averag	e Ambi	ent Mea	sured du	uring Qui	eter Nigh	ttime		
1-10	61	61	59	56	51	47	41	32	21	54
	City of Cambridge Noise Standards									
Commercial Anytime Residential Day Residential Night	79 76 68	78 75 67	73 69 61	68 62 52	62 56 46	56 50 40	51 45 33	47 40 28	44 38 26	65 60 50

Emergency generators not included in Project-Only sound estimates.

Average ambient sound levels based on the quieter second night data shown on Table 2.



	Octave Band Center Frequency (Hz)									
Location	31.5	63	125	250	500	1000	2000	4000	8000	Overall dBA
Watermark Condos-elevated (west bldg) 100 Memorial Drive Apts (elevated) Marriott Hotel (elevated) Kendall Hotel (elevated)	61 61 61 62	61 61 61 63	60 60 60 61	56 56 56 56	52 51 52 51	48 48 48 47	42 41 42 41	33 32 33 33	22 21 21 24	54 54 54 54
1 2 3 4 5 6 7 8 9 10	61 61 61 61 61 61 61 61	61 61 61 61 61 61 61 61	59 60 60 59 60 59 59 59 59	56 56 56 56 56 56 56 56 56	51 52 51 52 51 51 51 51 51	47 48 48 48 48 48 47 48 47 47	41 42 41 41 41 41 41 41 41 41	32 33 32 32 32 33 32 32 32 32 32	21 23 21 21 21 22 21 21 21 21	54 54 54 54 54 54 54 54 54 54

Table 4. Estimates of Total (Project + Ambient) Sound Pressure Levels and Overall A-Weighted Sound Levels at Elevated Receptor and Property Line Locations.

Totals include the Project-Only and Average Nighttime Ambient sound levels shown in Table 3. Emergency generators not included.

